Member of Associated Business Papers, Inc.

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Electrical Review

and WESTERN ELECTRICIAN with which is consolidated ELECTROCRAFT

Vol. 70—No. 24. CHICAGO, SATURDAY, JUNE 16, 1917. PAGE 997.

Give The Street Railway Its Due

AS a public utility striving to render a difficult service on a return which is widely recognized as inadequate, the street-railway system of today deserves a better reward than it is getting. The movement on behalf of higher fares is rapidly becoming country-wide. It has been accelerated by the extraordinary increases in the cost of labor and materials within the last few months, and in no small part appears to be one of the results of war conditions. The great traction organizations in New York City are seeking to impose a transfer charge of two cents despite the volume of traffic offered in the American metropolis, and in Massachusetts the Public Service Commission is now the Mecca of even the larger companies, who see in an increased fare at least a partial solution of their difficulties.

On the closing day of the Massachusetts Legislature Governor McCall sent a vigorous message to the two houses pointing out that unless street railways are granted more revenue the service which they render will be sought at less than its proper cost. It was proposed as a result of a long investigation of the affairs of the Boston Elevated Railway to pass an act authorizing the purchase of the Cambridge subway by the state, at a cost of over $9,000,000; but the Governor disapproved the entrance of the state into any scheme of public ownership whatever, and announced that he would veto the Elevated relief bill if this feature were not withdrawn. It was a courageous stand that the chief executive of the Bay State took upon the question of public ownership, and in referring the Boston Elevated relief question to the Public Service Commission for investigation, the Legislature removed the public ownership features of the bill, and it is a fair implication that the necessity for higher fares will be recognized in the case of the state's largest metropolitan company, although relief may be somewhat delayed by the apparently endless diet of investigations to which our Massachusetts friends are addicted. The Public Service Commission has lately granted several important fare increases to smaller companies; it has consented to the reopening of the Bay State Street Railway six-cent fare case inside the limit of time specified in its decision of last fall; and it is evident that further action along this line is to be expected. The Massachusetts companies can show a pretty clean bill of health, tested by the overcapitalization analysis, and nothing is more certain than that the public in the near future must meet the increased cost of their indispensable service, either through increased taxes associated with public ownership or abated burdens, or by higher rates under efficient commission regulation.

A Hysterical Tendency

THERE is an increasing tendency on the part of electrical organizations, as well as others, to postpone their annal conventions because this country is at war. This attitude is undoubtedly justified in regard to national conventions that necessitate members traveling long distances and that involve, further, the transportation and setting up of exhibits, thus adding to railway congestion and involving apparatus that perhaps could be better used in actual service. On the other hand the holding of state and even sectional conventions is certainly more necessary and advantageous now than at any other time, and there seems little need for the cancellation of such meetings that have proved so beneficial in the past.

A number of instances have occurred in which conventions have been canceled or postponed through a feeling that the expenditure which they entail is in the nature of an extravagance and ought not to be made at a time when the country is being adjured to husband all its resources. This view is a mistake. Convention meetings afford an opportunity for the interchange of ideas and the promotion of patriotic sentiments which must prove of the greatest value to the country.

The Merchants' Association of New York has given considerable study to this condition with the result that Mr. W. F. Morgan, president, has recently written a letter to President Wilson asking him to publicly discourage this attitude. Mr. Morgan states that "In our judgment this is a false idea of economy, the application of which will be harmful, rather than beneficial, both to the Government and to the Nation's business. Such gatherings, in our judgment, should be encouraged rather than discouraged, because failure to hold them as usual is likely to create a false impression, to stimulate a lack of business confidence and to discourage mutual co-operation which is so necessary under existing circumstances. Conventions and gatherings of different trades and industries afford

an exceptional opportunity on the part of business men composing them to study the effect of the war situation upon industries, so that they may be best equipped to serve the needs of the Government and to serve the normal business of the country. Both business and general conventions also afford exceptional opportunities for patriotic gatherings and the fostering of patriotic sentiment."

Cable Inventories in Manholes

IN estimating the total run of cable for a distribution-system analysis, the allowance to be made for manhole layouts is of some importance. The most accurate method is, of course, to record actual tape measurements of cable racking within each manhole. In some cases a large number of these measurements may show that a fair average for a system's later work may be, say, five feet of rack per cable per manhole. In other cases records of the cable fed from the reels on the street, compared with the distances between manhole centers as scaled from maps, will give the desired information. Each central-station engineer must determine the degree of accuracy which is worth while in his particular instance.

Cables by no means always traverse a half-manhole wall length, some entering and leaving by ducts whose center lines may be approximately at right angles to one another, if on the same level or even if on different levels, taking account of the projection. First-class construction records will go far to render subsequent detailed measurements unnecessary in many cases, provided these are kept up-to-date; but in any event, the engineering department of a central station should always be prepared to demonstrate exactly how its estimates or computations of cable length in manholes are reached, preserving the field sheets so long as the lines inscribed thereon in figures or in sketches, are a part of the distribution system.

Let Old Glory Wave

IN these war times it is hardly necessary to urge that on every street, from every home, every schoolhouse, every church, every factory and every store, every place throughout the land where people are gathered together Old Glory should wave. Unfurl your flag and throw it to the breeze. Publish broadcast over the land that sentiment—one country, one flag.

But do not confine your efforts to the outdoors alone, where the Stars and Stripes is a plaything of a fickle wind, one moment energetic and full of life, the next a listless sleeping thing, according to the wind's passing whim and mood. Indoors as well as outdoors let Old Glory wave before the breeze. Set up before it the electric fan to make a powerful breeze as strong and constant as a nation united in thought and purpose, and the flag will wave jauntily in the wind, as proudly as fluttered flag from any admiral's flagship that ever sailed the seas. Throw the rays of the electric light upon Old Glory, as may the light of justice and fairplay of democracy shine always wherever the Stars and Stripes may find its way. Thus let the Stars and Stripes wave in the halls of our office, administrative and railroad buildings, in the lobbies of our hotels, in our court rooms, in the sanctums of our churches and in our theaters. Wherever people are gathered together, for business, for pleasure or for worship let Old Glory wave before a powerful untiring current as portrays the spirit of a just and determined nation, united and unafraid.

The Stars and Stripes may wave where electricity is not. But let not there be electricity supply where Old Glory does not wave. Let not our flag hang listless, but have it blowing out full in the breeze, in all its beauty of star and stripe, every star showing, a country united, one purpose, one flag.

Turn on the electric fan, that our flag may bravely blow in the breeze, courageously vibrant with patriotism, confident in its honesty of purpose, sincere in its creed of justice and freedom—democracy. Let the electric light shine brightly upon Old Glory, splendent and inspiring, a beacon for the downtrodden; a light that has sent its rays of hospitality and comfort and kindness into those distant war-stricken sorrowful lands; a light that shines with but one purpose as shone that light of old with its message of good-will to all men.

A Model Power Supply System

THE maximum efficiency and economy attainable within reason is demanded of every industry since our country has become involved in the world war. The industries are responding effectively as is evidenced by the nationally co-ordinated operation of the railroad systems in order to eliminate the wastes of competition. That the electrical power supply industry can carry out similar economies through co-operative working is becoming manifest in several parts of the country, but probably most notably in the extensive power project associated with the large, new and in many ways remarkable power plant being built at Windsor, W. Va.

Through a series of three articles in the last three issues dealing with various elements of this project our readers have already become familiar with its salient features. A supplementary article in the present issue throws additional light on the Canton substation of this system. It will be apparent to all who have read these articles that the entire Windsor power system, although conceived several years before we entered the war, realizes in full the present demand for elimination of all possible waste in the transport and utilization of coal where water power is not available, for the maximum efficiency possible in the generation and transmission of power and for the co-operation of power-producing and distributing agencies to carry out these urgent needs in the conservation of our resources for national purposes.

HAPPENINGS IN THE INDUSTRY

E. N. Hurley Discusses War and Business Problems—Program for Special American Institute Meeting—A. A. Gray Leaves Staff of Electrical Review—Canton Substation Nearing Completion

E. N. HURLEY DISCUSSES WAR AND BUSINESS PROBLEMS.

No Abnormal Profits, but a Fair Margin Is Necessary Incentive for Increased Productive Energy.

Speaking before the World Salesmanship Congress in Detroit, Mich., on June 14, Edward N. Hurley, former chairman of the Federal Trade Commission, outlined the position which business men occupy in the present war.

"A large part of the burden of winning the war falls upon the business men," he said. "The boys in the trenches will do their bit; they will make all the sacrifices required of them. Those who stay at home must make sacrifices of a different kind, but unless they are made, the war will drag on indefinitely.

"Shortly there will be created in Washington a central purchasing commission for the United States Government and its Allies. If this agency provides a uniform system for purchases, such as the cost of production plus a reasonable profit, the basis will be established for sound business conditions throughout the nation.

"It is idle to talk about cutting the profit out of war. There should be no abnormal profits, but the normal profits of business should be maintained, because without such a fair margin of return on capital and labor there will be none of the incentive necessary for increased productive energy.

"The Government is now raising a $2,000,000,000 war loan through the Liberty bonds. The business men are contributing generously. Congress is working out a $1,800,000,000 taxation bill. The business men will pay most of this additional sum. It is necessary, therefore, that there should be a clear Government policy with respect to increasing the productive energy of the country.

"We should be able to meet the war bills out of our surplus energy. This is the best contribution that business men can make. There is no need for disturbing any wage or hour standard. If a man works eight hours a day, let him put a little more heart into his task and he will find that his productive energy will increase materially. Let the business man conduct his business a little more vigorously; let him work out his cost sheets; and get his prices where they ought to be, and he will find that he is making enough extra money to pay for taxes and liberty bonds. That should be his bit in the war."

PROGRAM FOR SPECIAL AMERICAN INSTITUTE MEETING.

Papers and Discussions Prepared for Annual Convention To Be Presented in New York June 27 and 28.

At its last meeting the Board of Directors of the American Institute of Electrical Engineers voted to hold a special Institute meeting in New York, June 27-28, 1917, for the presentation and discussion of papers that were to have been presented at the annual convention, which has been cancelled.

The Meetings and Papers Committee has arranged for five technical sessions which will be held morning and afternoon of each day and on Wednesday evening. The monthly meeting of the Board of Directors will be held Wednesday afternoon at 4:30 o'clock. The program is as follows:

FIRST SESSION, JUNE 27, 10:30 A. M. SUBJECT: HIGH-TENSION CABLES.

Problems in Operation and Maintenance of Underground Cables, by John L. Harper.

High-Tension Cable Joints, by D. W. Roper.

The Influence of Dielectric Losses on the Rating of High-Tension Underground Cables, by A. F. Bang and H. C. Louis.

Insulation Characteristics of High-Voltage Cables, by W. S. Clark and G. B. Shanklin.

SECOND SESSION, JUNE 27, 2:00 P. M. SUBJECT: HIGH-TENSION INSULATORS.

The Insulator Situation, by W. D. Peaslee.

Expansion Effects as a Cause of Deterioration in Suspension Type Insulators, by J. A. Brundige.

Present Practise in Design and Manufacture of High-Tension Insulators, by A. O. Austin.

The monthly meeting of the Board of Directors will be held at 4:30 p. m. Wednesday, June 27.

THIRD SESSION, JUNE 27, 8:30 P. M.

President's Annual Address.

Introduction of President-Elect E. W. Rice, Jr.

Reports of Technical Committees.

FOURTH SESSION, JUNE 28, 10:30 A. M. SUBJECT: MINING.

Forms of Power Best Suited for Various Loads Encountered in the Operation of Bituminous Coal Mines, by R. L. Kingsland.

Test of a Large Mine Hoist, by R. S. Sage.

FIFTH SESSION, JUNE 28, 2:00 P. M. SUBJECT: WATER POWER AND HEATING OF ELECTRICAL MACHINERY.

Economical Combination of Water Power and Steam Plants and a Convenient Method of Solution, by H. S. Putnam.

Cooling of Oil-Immersed Transformer Windings after Shut-Down, by V. M. Montsinger.

JOVIAN ORDER REMITS DUES OF ENLISTED MEN.

Patriotic Action Taken by National Organization Places Soldiers on Honor Roll.

Announcement is made in the June issue of *The Jovian* that the dues of all members who enlist in the military service of the United States or any of our allies will be cancelled during the war.

The enlisted members will be carried on an "Honor Membership Roll" without cost to them. Their cards, magazines and other Jovian material will be forwarded to them at the front and elsewhere whenever possible.

The central offices of the Order have requested all leagues to report enlistments of members promptly. Members are also requested to report their enlistment and where possible keep the central offices posted concerning their mail addresses.

AINSLIE A. GRAY LEAVES STAFF OF THE REVIEW.

Closes Fifteen Years of Continuous Service for Readers, Advertisers and Publishers.

An active, continuous service of fifteen years for all interested in this journal has been brought to a close by the resignation of Ainslie A. Gray, vice-president and general manager of the Electrical Review Publishing Company, Inc. Mr. Gray leaves the organization to carry out a long-cherished ambition to engage in business of his own. In this he has the best wishes of all his old associates, who while deeply regretting the severance of what have been such pleasant business and personal relations are eager to see him prosper in his new undertaking.

Mr. Gray's splendid career is a fine example of an American's achievement of success through his own unaided efforts and against great difficulties, for from quite early youth he was dependent on his own resources. Born in Brooklyn on August 1, 1877, he attended the public schools until 14, when the death of his father compelled him to give up an ambition to study medicine and to seek employment instead. This he found in various printing shops of New York, both small and large. In contrast to the large mass of youths of a metropolitan city, young Gray did not idle away his evenings after his day's tasks were done, but employed them usefully in continuing his education.

Ainslie A. Gray.

For nine years he attended the evening classes of Cooper Union and later of Columbia University in New York. These were strenuous years of constant application, during which were laid the foundations of a broad scientific and literary education and an extraordinary capacity for hard and persistent work. The Cooper medal and diploma were won in the five years' general and scientific course, after which a special course in English literature, rhetoric and composition was undertaken at Columbia under Professors Quackenbos and Butterick.

Throughout all this time Mr. Gray was also learning the printing business, being employed by day in several print shops and especially those of the large New York dailies, notably the *Journal* and *World*. Practically every branch of the printer's trade was mastered and then special study was given to typesetting machines, Mr. Gray serving as an expert in the development of inventions in this line in the interest of James R. Keene. He later became associated with the Merganthaler Company, and installed the first battery of Linotype machines in the plant of the James Kempster Printing Company, which was then the foremost printer of electrical publications, handling all the work of the ELECTRICAL REVIEW, the National Electric Light Association, etc.

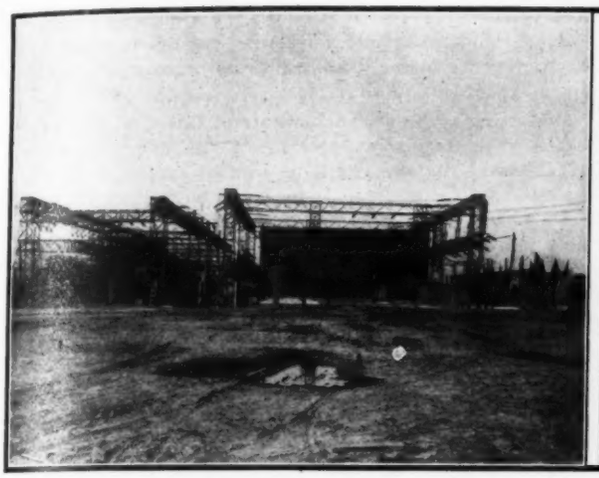
Here Mr. Gray became acquainted with the publishers of the ELECTRICAL REVIEW, and in 1902 joined its staff at a greatly reduced salary, but in furtherance of his desire to enter technical journalism, for which he was now well qualified in practically every way. Beginning as a proofreader on a special issue, he readily assumed editorial duties. In the latter part of that year the technical editor, Charles Tripler Child, died and a great deal of work was thrown on the young editor, until he was relieved of the additional duties by the appointment of William Hand Browne, Jr., to take up Mr. Child's work. Mr. Gray rapidly absorbed the publishing business, making such headway in it that in 1905 he was appointed managing editor, Mr. Browne retaining his title of technical editor.

On November 1, 1908, the Electrical Review Publishing Company purchased the WESTERN ELECTRICIAN, and Mr. Gray became the managing editor of the consolidated paper, and came to Chicago to take charge of the combined editorial departments. During the following year he was also made general manager of the company, thus assuming general direction of all its departments. In 1914 he was elected vice-president.

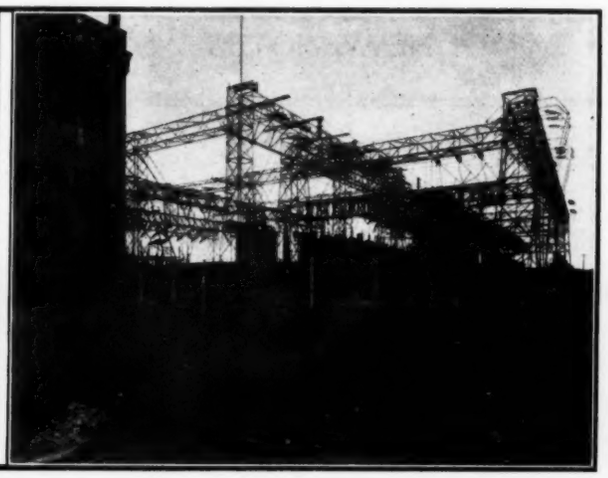
While broadening the business of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, Mr. Gray has taken active part in various electrical organizations, especially the Jovian Order, of which he was statesman-at-large and in whose behalf he has made countless speeches all over the country. He also aided in the organization of the Society for Electrical Development. In 1911-12 he was president of the Electric Club of Chicago. Through these and other electrical circles Mr. Gray has made a host of friends, and he probably is as well thought of as any man in the electrical industry.

For many years Mr. Gray has also been very active in publishing circles. In 1913 he was vice-president of the Chicago Trade Press Association and during the following year he served as its president. In 1915 he was elected president of the Federation of Trade Press Associations, which was the national organization of this industry. When this body was reorganized in March, 1916, as the Associated Business Papers, Incorporated, Mr. Gray was continued as its president, and at the annual meeting last October was re-elected for another year. Through the reorganization, which has been effected under Mr. Gray's leadership, this association has become a strong force in the upbuilding of the trade-publishing industry. Among notable things it has done is the defensive campaign carried on last winter against prohibitive postal rates, which required much attention by Mr. Gray.

Mr. Gray will continue to reside in Chicago, where in the southern portion of the city he has a comfortable home presided over by his charming wife and two daughters.



General View of Canton Substation, Showing 130-Kilovolt Yard at Right, 22-Kilovolt Yard at Left, and Condenser Building in Background.



Northwest Corner of Outdoor Switchyards with 22-Kilovolt Yard at the Right, Outgoing Feeders at Extreme Right and Building Corner at Left.

While severing his active connection with this journal, he will continue to give it of his generous counsel in matters of import to its readers and friends. With his old friend, Charles L. Benjamin, he has formed the firm of Gray & Benjamin, and will devote himself chiefly to technical advertising counsel to manufacturers of electrical, mechanical, chemical and kindred products. A more detailed announcement of this undertaking is found in another porton of this issue.

CANTON SUBSTATION NEARING COMPLETION.

Large Substation of the American Gas & Electric Company at Canton, Ohio, Almost Ready for Service.

In the last issue we published an article describing the remarkable substation being erected by the American Gas & Electric Company just outside of Canton, O. It is at the end of the 55-mile Windsor-Canton 130,000-volt transmission line and will furnish abundant power for the rapidly growing industrial needs of this progressive Ohio city. We have just received some additional photographs of this interesting station taken but a few days ago. These are reproduced herewith and serve to give a more complete idea of this undertaking. Work on the substation has been pushed with such vigor that it is easy to see the entire initial installation will be completed in ample time to receive power from the new Windsor power plant when the first unit of the latter is placed in operation.

The first illustration herewith gives some idea of the size of the substation. The extreme length of the switchyards, as shown by the width of this picture, is in the neighborhood of 200 feet. The lower picture shows the compact bulk of the 7,500-kilovolt-ampere synchronous condensers, which are the largest machines of this type ever built. Two of them are included in the initial installation. In the last view is shown the operating room as it now appears. The main operating benchboard at the right is so built that it can be easily extended to meet the requirements of the plant additions in the future without interfering with operation in the least.

This idea, in fact, is carried out throughout the design of this entire substation. Starting out with an initial capacity of 50,000 kilovolt-amperes in five large transformers, it will be enlarged in the not distant future to a capacity of 120,000 kilovolt-amperes in 12 transformers. That there is abundant room for this purpose can be seen in the foreground of the first picture. Extensions to even beyond this large capacity are not improbable and can easily be made.

View of Substation Building Showing One 7500-Kilovolt-Ampere Synchronous Condenser at Left and Corner of Operating Room at Upper Right Corner.

Operating Room with Remote-Control Benchboard at Right, Station Board in Center and Edge of Feeder Board at Left. Glass Walls Permit View of Condensers.

NEWS NOTES

Doherty Companies Co-operating in Liberty Loan Campaign.—Announcement is made that Ruth Law, the girl aviator who is at present making an aerial trip over the Middle West distributing literature on Liberty bonds, has been employed for this service by Henry L. Doherty & Company. Stops are made at all towns served by central stations under the Doherty management.

Ohio Commission Grants Rate Increase.—The Public Utilities Commission of Ohio has granted the Northwestern Ohio Railway & Power Company an increase in its wholesale and retail power rates amounting to practically 33.3 per cent; the rates to be covered by a tariff and approved by the Commission on the usual 30-day statutory notice. This will make the new rates effective August 1, 1917.

Emipre District Company Acquires New Property.—The Empire District Electric Company of Joplin, Mo., has bought out the electric light company in Baxter Springs, Kan., and is now furnishing the light and power for that town. Baxter Springs has a population of about 3,000 and is directly in the path of the great mining development which is headed that way from the Oklahoma fields.

Proposed Law for Computing Telephone Rates in New York.—The New York legislature has passed a bill providing that in fixing local telephone rates, the Public Service Commission shall allow for a fair return on the telephone company's plant investment, not only in the locality, but in the entire state. It is said that the measure was introduced to prevent a reduction of rates in New York City, and that Governor Whitman does not approve of the bill.

Electricity Used for Driving Cattle.—It is reported that an electrically charged rod for driving cattle is being introduced upon some of the ranches of Western Texas. It is said to be specially suited for making rebellious cattle enter dipping vats, branding pens and other enclosures into which it is ordinarily a difficult matter to drive them. The rod is constructed with four dry batteries and a coil and is equipped with a button by which the current may be turned on when it is desired to apply it to an animal.

Packard Electric Company Elects Officers.—At a recent meeting of directors of the Packard Electric Company, Warren, Ohio, the following officers were named for the coming year: president, N. A. Wolcott; vice-president, Charles Fillius; secretary, R. E. Gorton; treasurer, N. A. Wolcott. Mr. Wolcott, the new president, is well known, having been associated with the Packard organization in the position of treasurer for the past fourteen years. No small part of the firm's rapid growth during that time has been attributed to Mr. Wolcott's loyal and sincere work. No immediate change in the company's policy is contemplated by the new officers.

New York Jovians in Liberty Bond Campaign.—The Jovian League of New York City, through a committee headed by James H. Betts, has carried on a strenuous campaign in the interest of the Liberty loan with marked success. A roll of honor has been established, comprising all Jovians who have purchased bonds. The League has financed two plans whereby members could purchase bonds on a very liberal schedule of payments. One of the letters sent out by the committee states: "The committee gives you the opportunity to subscribe for bonds as a Jovian and not only to help the Government to equip and train the men who will represent us on the field of battle, but also to give evidence to the public of the spirit that has made the Jovian League what it is today."

Central Station Donates Sewing-Machine Motors to Red Cross.—The Harrisburg (Pa.) Light & Power Company has donated motors for sewing-machine operation, and electric service to the local Red Cross organization which is doing active work in Harrisburg.

Meeting of American Institute of Chemical Engineers.—The ninth semi-annual meeting of the American Institute of Chemical Engineers will be held at the Hotel Stadtler, Buffalo, N. Y., on June 20 to 22. A very interesting program of papers has been arranged, dealing largely with war-time subjects, and there will also be an elaborate entertainment program culminating in a one-day excursion to the Buffalo Canoe Club.

To Permit Use of Electricity for Flour Manufacture.—A bill has been introduced in the Pennsylvania legislature, and passed by the house, repealing the present law prohibiting the use of electricity in flour manufacture. The proposed law will require that the fact of the use of electricity shall be printed upon each package of flour offered for sale. The Pennsylvania Millers' Association is active in urging the adoption of the new law, holding that many well known experts agree that flour so treated is found to be absolutely wholesome.

New York Telephone Society Elects Officers.—At the annual meeting of the Telephone Society of New York, which was held on June 12, J. J. Thorp, division plant superintendent, New York Edison Company, was elected president; R. H. Boggs, vice-president, and J. D. Newman, secretary-treasurer. Following the election of officers, Arthur G. Empey of the British army, who has lately returned from the front, delivered a thrilling address dealing with his experiences in the trenches. Mr. Empey is a former employee of the New York Telephone Company.

Wiring Plan of Duquesne Light Company.—The Duquesne Light Company, Pittsburgh, Pa., is actively promoting a house-wiring plan throughout the city and neighboring sections. The company offers to wire six rooms and install fixtures for $67.55, with payment of $12.55 upon the completion of the work and $5 a month for eleven months, in all parts of the city. In the suburban districts now reached by the company's lines, the offer includes the wiring of a six-room house, furnishing drop cords and shades, with the elimination of wall switches, at a price of $29.50. This is payable at the rate of $7.50 upon completion of the work and $2 per month for a period of eleven months.

Large Electric Locomotive Completed by Pennsylvania Railroad.—The Pennsylvania Railroad has completed the construction of a large electric locomotive at its Altoona, Pa., shops for use on the mountain division between Altoona and Conemaugh, a section of road which is now being equipped for electric operation. The locomotive is the first of a number of similar type to be built. The unit measures 76 feet, 6.25 inches, over all, with weight of 240 tons; it is capable of developing a maximum of 4,800 horsepower and has a tractive force of 87,200 pounds, with speed of from 10.3 to 20.6 miles per hour over the heaviest grades, and can be operated in either direction.

Public Service Commission Disapproves of Municipal and Domestic Lighting Contract.—The Public Service Commission, Pennsylvania, has denied approval of a contract made by the borough of Girardville with the Schuylkill Electric Company for street and domestic lighting for a period of ten years. As a reason for this disapproval the commission says: "As the contract for street lighting and contract for domestic lighting are inseparably connected, we are of the opinion that it is neither necessary nor proper for the service, accommodation or convenience of the public that either contract be approved. The commission would approve the street-lighting contract if same had not been bound up with the contract for domestic lighting."

Interconnected Hydroelectric System

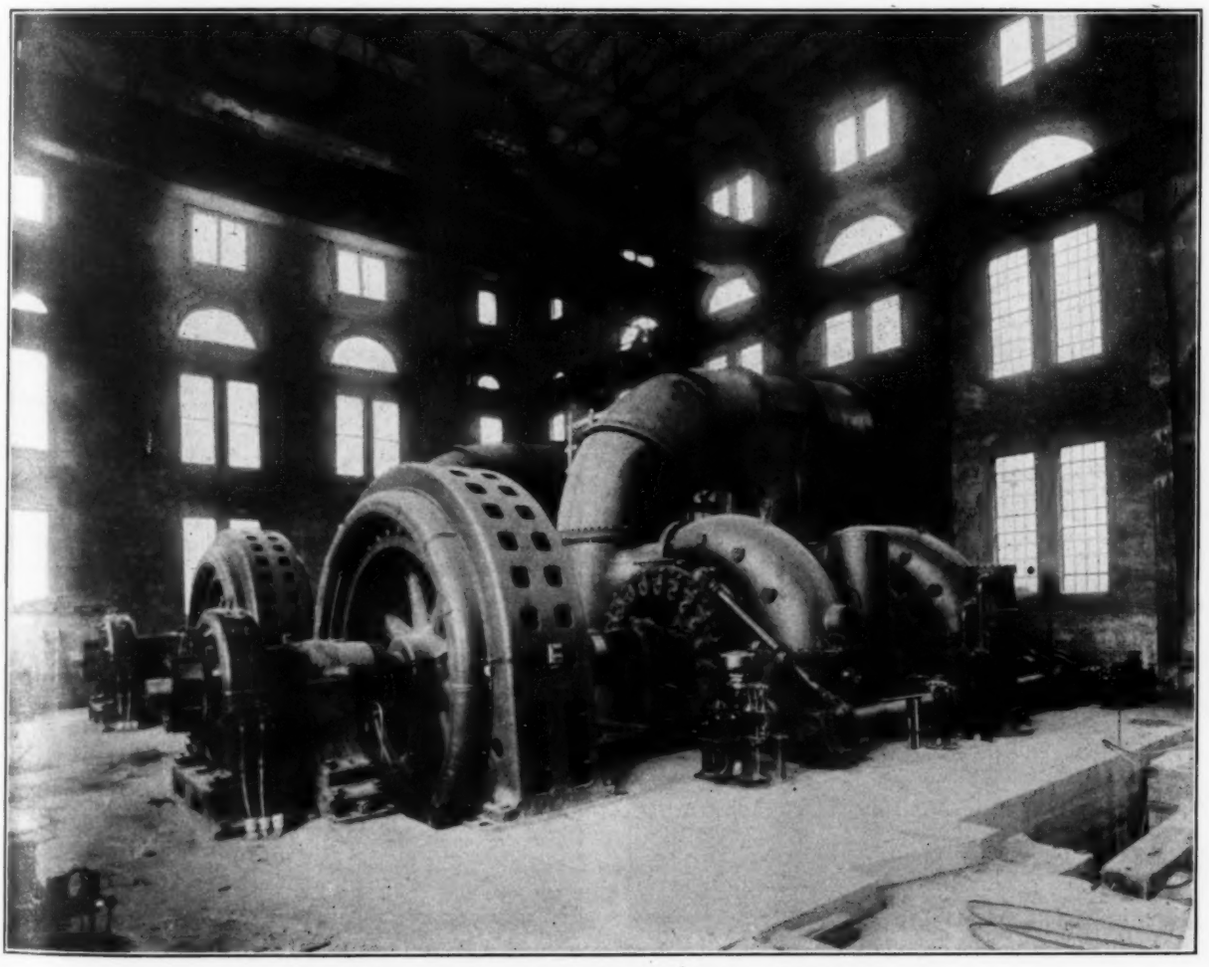
Washington Water Power Company Operates Four Modern Generating Stations Which Are Connected By a Network of High-Tension Lines Insuring Economical and Continuous Operation

THE purpose of this article is to deal with several interesting features of the hydroelectric plants, transmission lines, and distribution system of the Washington Water Power Company, Spokane, Wash. The four power stations of the company are situated on the Spokane River which has a maximum flow of 40,000 second-feet, and a minimum of 1500 second-feet. This stream is a tributary of the Columbia River and is the outlet of Coeur d'Alene Lake, in Idaho. The four plants, designating them in the order in which they were built, are situated as follows: Spokane station, at the lower falls in the center of the city; Post Falls station, located on the middle channel of the river, 10 miles below the lake outlet, near the Post Falls, Idaho, and about 20 miles east of Spokane; Little Falls station, 30 miles northwest of Spokane; and Long Lake plant, situated at a horseshoe bend in the river, 6 miles up-stream from the Little Falls station.

The original plant, within the city limits, has been in operation 15 to 18 years, and has been described frequently in public print. It contains two Platt Iron Works Francis turbines, each direct-connected to a 2250-kilowatt alternating-current generator, and other units consisting of water wheels and direct-current generators of sizes ranging from 200 to 1200 kilowatts, giving the station an aggregate capacity of 8800 kilowatts. The company also has, within the city limits, an auxiliary generating plant, operated by steam power. This plant is equipped with twelve 500-horsepower Babcock & Wilcox boilers, and two Curtis vertical steam turbines, one of which is connected to a General Electric 13,200-volt generator of 9000 kilowatts capacity, and the other to a 5000-kilowatt capacity generator of the same make. This auxiliary plant, though held in reserve, is not in operation at this time.

Post Falls Development.

The Post Falls plant, completed in 1910, contains five operating units, each consisting of a Francis horizontal, central-discharge, double-runner water wheel, operating under a 50-foot head, and each one direct-connected to a 2250-kilowatt, 2300-volt generator. This voltage is stepped up from 2300 to 60,000 volts by three-phase, 2200-kilowatt transformers; and from this station there are four outgoing transmission lines of 60,000 volts each, and one of 23,000 volts. One of the 60,000-volt lines serves the Coeur d'Alene mining district, another one extends north 40 miles to Newport, Wash.,



Long Lake Generating Station of Washington Water Power.

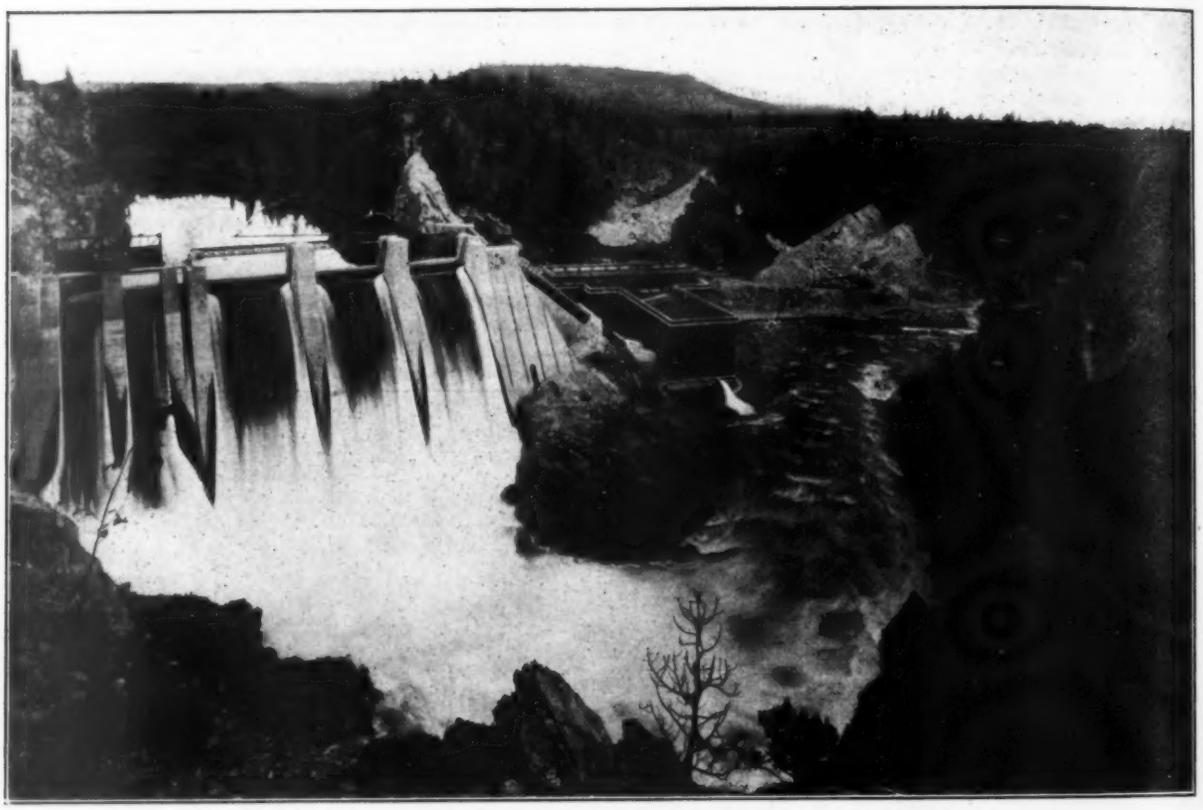
and the other two 60,000-volt lines connect with the Twenty-ninth Avenue substation in Spokane; while the 23,000-volt line supplies current to the Inland Empire Railway system. As noted above, the Post Falls plant is located on the middle channel of the stream. A short distance above Post Falls the river forms into three channels which join together again at a point some distance below the falls. By means of dams and controlling gates on the North and South channels the head waters may be raised 10 feet higher than normal low water. On the North channel are two 53-foot bear-trap gates and eight tainter gates, seven of the latter being 21 feet wide, and one 12 feet wide. The South channel dam has a 37-foot spillway and six 6 by 13-foot gates.

Little Falls Station.

This plant was completed in 1910. Power was developed on the Little Falls site by constructing dams of cyclopean masonry, making a storage basin, the back water in which extends up stream 4.5 miles. The aggregate length of dam construction was 1716 feet. The spillway dam, which at the highest point is 64 feet high, has a length of 650 feet. The plant is made up of four units, each unit consisting of a 5500-kilovolt-ampere three-phase, 60-cycle, 400-volt generator, driven by a 9000-horsepower I. P. Morris horizontal twin water wheel. It is stated that these water wheels are equal to 11,250 horsepower each when running under a 73-foot head, at 150 revolutions per minute.

The transmission lines extending out from Little Falls station consist of a three-wire cedar-pole line, carrying 60,000 volts, westerly to Davenport, Wilbur and Hartline, and another similar line to Long Lake; and a double-circuit steel-tower, 60,000-volt line to the Twenty-ninth Avenue substation in Spokane, a distance of 26.5 miles. Further on are given some facts relative to pole and tower-line construction.

The most recent hydroelectric development of this company was at Long Lake, where the Spokane River, in making a horseshoe-shaped bend, flows within a box canyon having granite walls rising 350 feet above the water. The site selected for the spillway dam was across this canyon, on the upstream curve of the horseshoe. The completed dam, illustrated herewith, is of cyclopean masonry, 353 feet long, 208 feet high, and 250 feet thick at the base; and the power station is situated 250 feet below the spillway on the lower course of the river curve. The headgate dam, which is joined to the left-bank end of the spillway dam, and which runs at right angles to it, has a length of 240 feet, a height of 100 feet, a thickness at base of 100 feet, and 18 feet width at the top. The third dam is an arched cut-off structure, built across a gulch to hold back an overflow at a point on the river 900 feet above the spillway. This dam is 260 feet long, 100 feet high, 50 feet thick at the base, with an upstream face radius of 170 feet. The foundations for all this dam construction



Long Lake Hydroelectric Plant of Washington Water Power Company.

were in solid rock, and this involved a large amount of rock excavation.

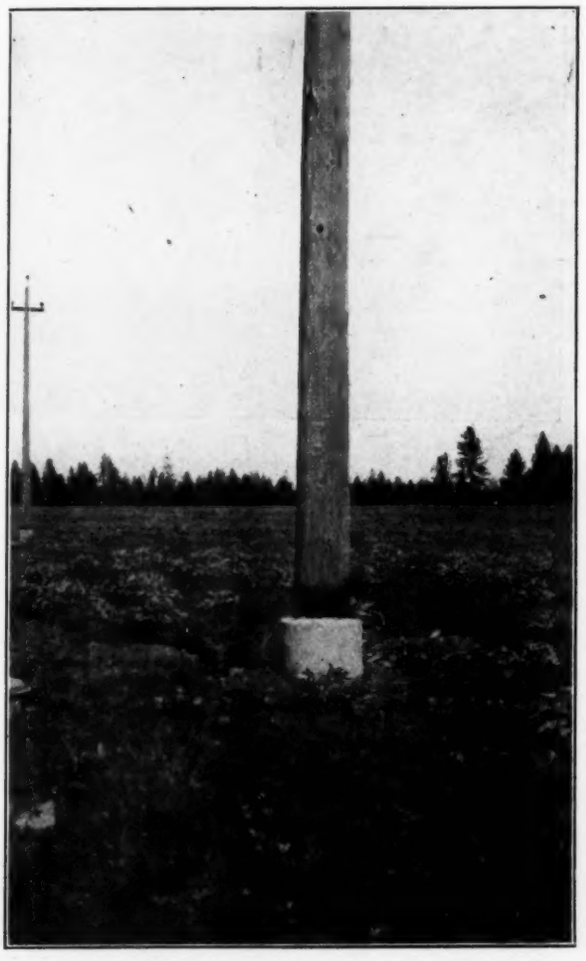
The four penstocks, extending through the masonry of the head-gate dam to the turbines in the power house, have a length of 236 feet, the diameter being 16 feet at the upper end, and 14 feet 10 inches at the lower end. They are constructed of steel plates varying in thickness from 0.5 inch at upper end to 0.9375 inch at the lower end, and having 6 by 8 by 0.75-inch stiffener angles, 5 feet apart for the full length. Each of the four hydroelectric units consists of a 22,500-horsepower Francis turbine of the double-inflow horizontal type, made by I. P. Morris Company, direct-connected to a 13,900-kilovolt-ampere, 400-volt, three-phase, 60-cycle generator. The turbine has 83-inch twin runners within cast-iron volute casings, and operates at 200 revolutions per minute under a 168-foot head. An efficiency of 91 per cent has been demonstrated by tests made. The double-floating, lever-arm, oil-pressure type of governors operate under a pressure of 200 pounds. The generators can be operated continuously under a 25 per cent overload; and when given 60,000 cubic

Little Falls Plant in Distance.

Close View of Little Falls Plant.

feet of air per minute, can carry an additional load of 12 per cent. The air is supplied by tunnels directly entering the generator pit. There is a bank of three single-phase 6500-kilovolt-ampere transformers for each generator. They were at first delta connected and operated at 63,600 volts, but later plans provided that they be delta-star operated at 110,000 volts. All equipment is housed in a T-shaped brick building, having concrete foundation. The generator and wheel room is 75 by 160 feet, with a height of 65 feet. The part occupied as transformer, switchboard and high-tension rooms is 86 by 207 feet and 87 feet high. The transformers occupy a floor one foot higher than the main floor level, with the machine shop separately inclosed back of them. The operator in the switchboard gallery above the transformer room has a clear view of the wheel and generator room. This room is provided with a 90-ton electric crane, and the mezzanine floor of machine shop contains a storage battery. The second floor contains the high-tension oil switches, dis-

Concrete Jacket Used by Washington Water Power.



Treated Poles Equipped With Concrete Jackets.

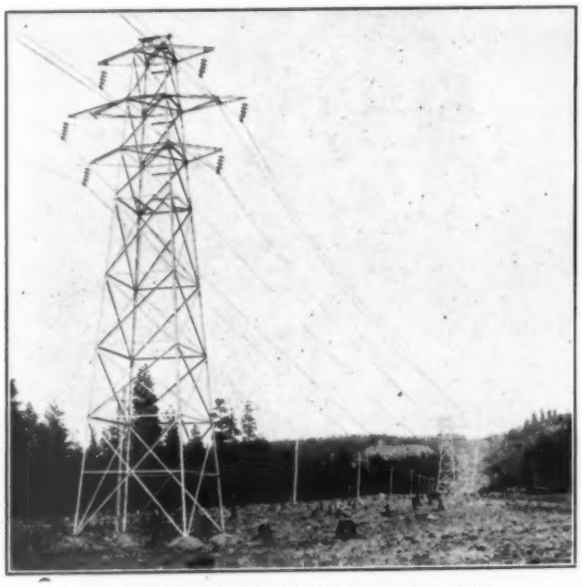
connecting switches, and high-tension buses; the lightning arresters, high-tension current and potential transformers, and line disconnecting switches are on the third floor.

The headgates, each 21 by 19 feet, are made of I-beams and plates and work by means of wheels, the axles of which are mounted upon eccentrics, the wheels themselves moving on a vertical rail concreted in the face of the dam. The gate mechanism is operated by motors, with arrangements for dynamic braking when the gate is being lowered. There are three rolling gates and two waste gates for controlling the flood waters. The rolling gates afford an opening 19 feet high and 65 feet long. Concrete piers separate the gates from each other, and the operating equipment is placed on top of the piers. Gate leakage is restricted to a maximum of one cubic foot per second by water seals.

The Long Lake plant has not been operated continuously since its completion, due to the fact that demands for power have not required it, but it is stated that the plant will be in continuous operation by next autumn.

Transmission Lines.

The territory served by this company's transmission lines for light and power is described by a circle having a radius of 100 miles, with Spokane as the center. Within this circle there are over 600 miles of 60,000-volt lines. The major part



Double-Circuit 60,000-Volt Transmission Line.

of this mileage consists of three-wire lines carried on pole lines of Western red cedar. When the 40-mile cedar-pole line was built from Post Falls to Newport, a Siemens-Martin 3/8-inch steel cable was strung along the line and attached to the peak of each pole, and a ground wire extended therefrom. The primary purpose of this steel line was lightning protection, but it was also found to give stability to the entire line. It was observed that electric storms strike through the Post Falls-Newport region at right angles to this transmission line, and the freedom of that line from interruption during such storms showed that the steel ground wire afforded decided protection, and similar installations were made on the other lines.

Some of these three-conductor pole lines carry secondary transmission wires for distribution service. The poles vary in length from 35 to 50 feet, and are planted from 5 to 7 feet in the ground. The butt end is creosoted from the base up to 18 inches above the ground surface. In actual practice a portable creosoting tank on trucks is taken along the line and the pole ends treated where the poles are unloaded. This is done by pouring the hot mixture over the parts to be treated. In a good many cases in which the grounded end of the pole had rotted, the part affected has been given a concrete jacket after specifications of the Harding process. This solidifies the pole base and extends its life many years, and as the concrete jacket, or sleeve, extends 2 to 3 feet above the ground the pole is shielded from grass fires. The cost of such work, as estimated by George Harding, patentee of the process, is close to $5 per pole. No estimate of costs, however, are given out by the power company. In other cases of repairing wood poles the practice is to sink a wooden stub by the side of the pole and lash the two together with iron bands or heavy wires. The pole spacing ranges from 125 to 1400 feet, spans of the latter length being mostly on mountain lines. In the level and undulating region around Spokane spacings average 200 feet; in about 200 miles of line, however, they average 300 feet. Pole line conductors comprise several types, including copper, No. 5 to No. 000, inclusive; copper-clad, made by dipping a steel ingot into a copper bath, and drawing it out hot; steel-cored aluminum, and straight aluminum. In all pole-line conductors the pin-type insulators are used.

An interesting feature is the 28-mile double-circuit steel-tower transmission line from Little Falls power station to the high-tension, step-down substation at Spokane. The design of steel tower, and steel cross-arms and insulator units, is shown in one of the accompanying illustrations. The towers have a height of 50 feet, are 16 feet square at the base and 4.5 feet square at the top. They are constructed of 4 by 4 by 5/16-inch galvanized angle iron, bolted together, and braced with angle bars. Some of the angle-iron posts are anchored at the base in concrete, and others rest upon flat channels 5 to 6 feet in the ground. It will be observed that there are three steel cross-arms. These are made of 4-inch, 5.25-pound channel iron. The conductors on each side of the tower are 7 feet apart vertically; each conductor is composed of a 19-strand, 270,000-circular mil aluminum wire, and is suspended from the cross-arm by four 10-inch diameter insulator units, the length of complete insulator and cable clamps being 34.25 inches. In addition to the double-circuit, 60,000-volt transmission lines, the towers carry two 3/8-inch Siemens-Martin galvanized steel cables, attached at the peak of the tower, for lightning protection. There are 225 towers on the 28-mile line, making an average spacing between towers of 625 feet.

Substations.

There are 30 substations in the territory covered by the company's transmission lines. These comprise brick, steel and outdoor stations. The last named is adopted in locations where there may be some doubt as to permanent demand for the service. In Spokane, there is the Post Street substation, from which most of the current used in Spokane is distributed. This has a 12,000-kilowatt installation, but was designed for 30,000-kilowatts capacity. Also here is the Twenty-ninth Avenue high-tension switching substation, from which all the 60,000-volt lines connect the various plants with the several outlying districts. The transformers at this station consist of five three-phase, 13,200 to 60,000 volts, having a capacity of 13,300 kilowatts.

For distribution in the city of Spokane cedar-pole lines are employed. Many lines have 7 or 8 cross-arms, the heaviest loaded line, beginning at the top, having four circuits, 13,200-volt three-phase, 4000-volt three-phase, 2300-volt single-phase, and a 600-volt railway feeder. Current from outside plants comes in on overhead wires. The underground system covers an area in the city of one mile by three-fourths of a mile. While there is a limited number of clay conduits, most of the underground lines are carried in fiber conduits, embedded in concrete. An interesting matter is the system developed in keeping an up-to-the-minute record of the condition, location and changes in all cable lines, duct lines and pole lines.

Measurement of Ground Resistance

The Various Methods for Measuring the Resistance of Earth Connections, Precautions Necessary to Secure Reliable Results, and Data on Actual Resistance of Artificial Grounds Found in Over Thirty of Our Cities as Determined by the Bureau of Standards

GROUND CONNECTIONS are becoming of increasing importance in electrical circuits since the grounding of neutral conductors and transformer secondaries has become mandatory. For a long time it was believed that almost any kind of connection with ground would serve the purpose, but experience has clearly shown that the connection must be one of minimum possible resistance, not only at the time of installation, but throughout use. This means that a check on the value of ground connection must be available both by general inspection and actual resistance measurement.

The measurement of ground resistance, while not extremely difficult, requires considerable care in order to secure readings of any value. An exhaustive study of this subject has been made by the Bureau of Standards, Washington, D. C., as the result of which a very valuable report is soon to be published. An excellent advance summary of this work has been made by Dr. Stratton, director of the Bureau, in a special communication to the Committee on Bare Grounded-Return Wiring Systems, the report of whose findings was given in the issue of May 12, 1917.

In this communication, which the committee is calling to the attention of all interested in the subject, particularly electrical inspectors, Dr. Stratton says that the ammeter-voltmeter method is the most reliable and convenient, and should be used where either alternating-current or direct-current circuits are available from which power may be taken. Alternating current, however, is to be preferred to direct current.

Advantages of Alternating-Current Ground Measurements.

The chief advantage in the use of alternating current lies in the fact that a transformer which transforms energy in the ratio of 1:1, or any other convenient ratio according to circumstances, can be connected to a low-voltage alternating-current circuit to provide a measuring circuit that is cut off by insulation from all disturbing influences due to grounds of any kind which may exist on the circuit from which power is being taken. And, in addition, nothing in the way of polarization effects or of stray currents of any kind in the earth are likely, with alternating current, to interfere with the measurements to an appreciable extent.

Equipment Needed for Ground-Resistance Testing.

To keep the required number of instruments at a minimum, a transformer may be used, the secondary of which is wound for several voltages; the voltage range may well be 30, 60, 120, and 240. Then a single ammeter and usually but two voltmeters are all that are necessary for measurements under ordinary conditions. Satisfactory results will be obtained in nearly all cases with an ammeter of 2-10 ampere scale and one voltmeter reading, say, 80-300 volts and another 20-75 volts. To make such an outfit readily portable, the transformer should be small; its rating need not be greater than 0.5 kilowatt. The size permits of connection to house lighting or power circuits and will give sufficiently high current readings for accurate measurements upon any earth connection which is fit, as far as resistance is concerned, for earthing electrical circuits or equipment. In addition to the transformer and measuring instruments, 200 feet or more of flexible cord, well insulated and mechanically protected, capable of carrying 20 amperes at least, and of known resistance per unit length, should be provided for the purpose of reaching such earth connections in the near vicinity of the one upon which measurement is being made as will serve the purpose of auxiliaries. The cord should be cut in lengths of 50 feet with two-way connectors or other device for making temporary splices when necessary. In this way the work may be facilitated a great deal in some cases by saving labor in making auxiliary earth connections.

Measuring Method Using Alternating Current.

To obtain the resistance of one earth connection, two auxiliary earth connections are necessary, or one the resistance of which is known. In either case the electrodes must be at some distance from each other, the farther the better, but with electrodes of limited extent, such as driven pipes or plates, at least 15 feet for reasonably accurate work. For at 15 feet the mutual influence of the electric fields about two neighboring electrodes can be neglected as far as practical purposes are concerned. And if voltage is impressed upon two of them in series the measured resistance to flow of current from one to the other will be very nearly the sum of the resistance to flow of current away from each one. Hence, if R_1, R_2, R_3 represent the individual resistances, and r_1, r_2, r_3, the resistances of each pair in series, it follows that the equations $R_1 + R_2 = r_1$, $R_2 + R_3 = r_2$, and $R_3 + R_1 = r_3$ are a fair approximation to the actual relationship existing between these various quantities. Solving:

$$R_1 = (r_1 - r_2 + r_3)/2.$$
$$R_2 = (r_1 + r_2 - r_3)/2.$$
$$R_3 = (r_2 - r_1 + r_3)/2.$$

Therefore, by measuring the resistance of each pair in series, and substituting in these equations, results may be obtained which show very closely the actual resistance to flow of current away from each electrode. But it is to be remembered, as pointed out above, that in every case the electrodes must be at some distance from each other. Otherwise absurdities may arise in the calculations, such as zero or even negative resistances.

A disadvantage of the foregoing method is that it involves three measurements and considerable computation.

Short-Cut Method.

In some cases it is practicable to reduce the time and labor required by passing current through two of the earth connections in series and measuring the voltage between the one the resistance of which is to be found and a third or potential terminal. The resistance is then calculated simply by substituting in $R = E/I$. Under favorable conditions good results may be obtained in this way.

There is a source of error, however, which must be guarded against. That is, if the resistance of the third (or potential) earth connection is sufficient to be comparable with that of the voltmeter, a considerable discrepancy will be introduced into the calculated values, because the voltage reading will be proportionately less than the actual voltage. And unless a correction is made, the resistance being measured will also appear to be less than it really is. Reasonable assurance must be had, therefore, that the conductance of the earth connection in series with the voltmeter is high enough to avoid serious error. There may, of course, be some question as to what constitutes a serious error, but it seems that in such

work as this, where approximate results are all that are required, an error need not be considered serious unless it exceeds 10 per cent.

To test the third or potential terminal mentioned above to determine whether its resistance can be neglected, put a known resistance in series with the voltmeter. Let this resistance be equal to that of the voltmeter. Then take two readings, one with the resistance in circuit and another with it cut out. If the first reading is approximately half that of the second, the resistance of the potential terminal can be neglected. If the first is considerably more than half that of the second, however, the resistance of the potential terminal is too high. In this case measure the voltage between the potential terminal and each of the current terminals, and also the total voltage. Then the total voltage is shared by the current terminals in proportion to these readings.

Method for Rough Calculation.

For very rough work the potential terminal may be dispensed with entirely, and measurements made by passing current through two earth connections in series, measuring the current and total voltage, and assuming that the resistance of each earth connection is half the total. In this case, however, the electrodes must be alike and be embedded in the same kind of soil to obtain dependable results. It should be emphasized here that the latter method involves much less labor and calculation than the method where three current terminals are required.

Measuring Method Using Direct Current.

It has previously been remarked that alternating current is preferable to direct current for making measurements upon earth connections. There are places, however, where only direct current is available. And with it fair results may be obtained, but it is necessary to avoid sources of error which are negligible or do not exist where alternating current is taken from a special transformer.

Polarization Error Counteracted.

In the first place, the back electromotive force of polarization is a considerable quantity with direct current, and to counteract it the applied voltage must be made large enough to make its effects of no consequence in comparison. For this 100 volts is sufficient, because the back electromotive force of polarization is not likely to be more than 2 or 3 volts, and hence, with 100 volts applied, will not introduce an error of more than a few per cent. This means, of course, that 100 volts, or at least a large part of it, is actually to be applied to the earth connection under test, so when measurements are being made with direct current, account must be taken of the fact that the total impressed voltage is shared by two earth connections in series. And if the resistance of the one under test is low, while that of the other is high, the division of voltage may be such that the effects of polarization introduce a considerable error. It is necessary, therefore, to see that the voltage is properly shared, which can sometimes be done only by making or choosing auxiliary earth connections of resistance equal to, or preferably less than, that of the one being tested. Under these conditions results practically as good as those from alternating current are obtainable, although direct current is not so convenient to work with.

Caution Concerning Earth Connections.

In the second place, with direct current, care must be taken to ascertain whether there are earth connections on this circuit from which energy is being drawn other than the one being investigated. If there are none, the measurements may be allowed to go forward in the manner described above, using two auxiliary earth connections. But if earth connections exist, and it is impracticable to disconnect them, this method must in some cases be discarded because of the errors introduced by the flow of cross currents. However, if the earth connections already existing are of sufficiently low resistance for use as one of the auxiliaries, the test may be conducted in accordance with the second method described above, in which a single measurement, and one auxiliary earth connection near at hand are all that is required. That is, the earth wire is simply attached to one side or the other of the circuit, the current measured, together with the voltage between the electrode under test and the auxiliary earth connection, and the resistance computed from $R = E/I$.

Auxiliary Ground Connections.

Where alternating current is used, the making of auxiliary earth connections will not in many instances be found burdensome. In fact, where there are three or more houses or other buildings in a block in which there are lighting circuits, the earth connections already made can be utilized if they are not made to water pipes, since three separate electrodes are necessary and a water pipe constitutes but one. Or, if there are no existing earth connections within reach, two short pipes driven in the ground will serve very well, and, if desirable, can be removed after the measurement is made. If these pipes are as much as two feet in length, resistances not exceeding 40 to 60 ohms are obtainable in most soils if the surrounding ground is well soaked with water. This resistance will in nearly all cases be found low enough, and in any case the resistance of the auxiliaries may be several times the resistance being measured. It is necessary only that sufficient current flow be obtained to enable fairly accurate reading of the ammeter. With direct current, however, it is best, as pointed out above, to make the resistance of the auxiliaries not much exceed, or be even less than, the resistance being measured, in order to minimize the effects of polarization. The consequent difficulty in always securing suitable auxiliary earth connections constitutes a considerable disadvantage in the use of direct current for testing purposes.

Wheatstone Bridge Measuring Method.

On the other hand, where electric power or lighting circuits from which current may be taken do not exist, fair results may in some cases be obtained by the use of an ordinary Wheatsone bridge with an easily portable source of alternating or oscillating current. The bridge should preferably be one of the type commonly used for field work, such as a Leeds & Northrup type "S" testing set. For detecting a balance, a moderately sensitive telephone receiver may be used. The source of current may be a hand generator, or a battery of dry cells operating either a buzzer or a telephone howler through the primary coil of a small transformer. More or less satisfactory operation is obtainable with either of the latter, although the buzzer will probably be found the least troublesome. The most suitable types of buzzer are those used in radiotelegraph work, which can be made to give interruptions at a rate of several hundred per second.

Test Procedure and Precautions.

The method of procedure in making measurements is the same as for the ammeter-voltmeter method, i. e., with three earth connections at some distance from each other, the resistance of each pair in series is measured and the results substituted in the equations given above. If there are no disturbances from earth currents it is possible by this means to arrive closely enough for practical purposes at the actual resistances sought. But if there are stray alternating currents in the earth, or even current from direct-current railways, the readings may be interfered with to such an extent as to make them worthless. These currents produce noises in the telephone receiver, the noise from the direct current being due to commutation.

It is possible, however, in two ways to overcome their effects, or at least to reduce them to a certain extent. First a buzzer may be used having a note much different from the sounds produced by the disturbing currents. Second, where

auxiliary earth connections are made at the time of the measurements it may be practicable to place them, and also the earth connection being tested, in a line which runs at right angles to the direction of flow of the earth currents. In this position the electrodes will all be at the same potential, or nearly so, which will produce zero current, or but very slight current at most in the bridge circuit. Nevertheless, neither of these expedients is infallible, and it will, as a rule, be found very difficult to reduce noises from stray currents to a sufficient extent to not drown the sound produced by the bridge current itself, especially when the bridge is near a balance. Therefore, the Kohlrausch bridge method is to be considered as of practical use only at great enough distances from sources of stray current to make their effects small. And with a telephone receiver of moderate sensitiveness, and a bridge current giving a note much different from that of the disturbing current, fair results are then possible.

Current-Carrying Capacity Measurement.

To test for the maximum current which an earth connection will carry without drying the soil, or, in other words, the capacity of an earth connection to dissipate energy, requires an auxiliary earth connection which can carry a greater current without a material increase of resistance than the one being investigated. Otherwise the auxiliary will fail, and all the knowledge that will be gained will be comprised in the fact that the earth connection under test can dissipate energy at a higher rate than the other. In few cases, therefore, will it be found practicable to carry out satisfactory experiments unless the trouble and expense are incurred of making very elaborate auxiliaries. This difficulty does not arise, of course, where the earth connections to be investigated consists of several electrodes in parallel, for it may in such cases be possible to test each electrode separately, using the remaining ones as auxiliaries, and assuming that the total capacity to dissipate energy is equal to the sum of the individual capacities. Nor does it arise where there are water pipes within reach, although ordinarily under such circumstances the water pipes themselves should be used for earthing, which does away with the necessity for tests. But to investigate a single isolated electrode requires the installation of a second earth connection of even greater conductance than the first. Local conditions will determine to a large extent the exact manner in which a test may best be conducted.

If power is supplied from transformers the capacity should, for the best work, be sufficient to run the rate of consumption of energy up to about 100 kilowatts at 1,100 volts. A larger power rating than this will hardly be required in any case, and in many, in fact, a smaller rating will do very well. Means should be provided for varying the voltage through rather a wide range, such as a water rheostat in the primary circuit. The current should be measured, and also the voltage between the earth connection under test and a reference electrode embedded in the ground at some distance away. For these measurements current and potential transformers will be needed.

The first step in the experiment is to estimate the current which the earth connection will safely carry, and regulate the voltage accordingly. At the end of a half hour or so, if the current flow has not changed, it should be increased. Successive increases of current should be made until steam begins to come off. On the other hand, if the current at first is too large, and steam comes off very shortly, it must be decreased. In either case the current must be reduced until steaming ceases and then allowed to flow for several hours. If there is no appreciable increase of resistance the value of the current flow at the end of that time may be taken as the maximum which the earth connection will carry without drying the soil. But if an increase of resistance does occur, the current should be still further reduced until the resistance remains constant or nearly so. From the current and voltage, the rate of dissipation of energy can be calculated, the voltage, as stated above, being that measured between the electrode under test and a reference electrode embedded in the ground at a distance of 15 feet or more.

General Conclusions as to Measurements.

From the foregoing description of methods of making tests, it is evident that where proper equipment is provided resistance measurements are readily made at relatively small expense. With regard to capacity to dissipate energy, however, the cost of tests is much greater. In fact, to test every earth connection in this way would cause the expense to mount to a prohibitive figure. A better procedure is to make a few earth connections at points where a large supply of power is available and test them thoroughly to find out roughly the relationship which exists between the capacity to dissipate energy and the resistance. Then, if the soil where these test electrodes are buried is typical of the locality, it is possible from resistance measurements alone upon other earth connections to determine in a rough way at least whether these are likely adequately to serve the purpose for which they are installed. To assist in making a proper interpretation of resistance measurements upon earth connections other information is also desirable, mainly data on the effect of the

TABLE 1.—RESISTANCE OF ARTIFICIAL GROUNDS IN DIFFERENT CITIES.

No.	City.	Soil.	Type of Ground.	Av. Res.	Min. Res.	Max. Res.
1	Newark, N. J.	Clay and marsh land	Driven pipes	10a	2.5	800
2	Paterson, N. J.	Stone, clay and sand over rock	Pipes and steel poles	340	20.	700
3	Elizabeth, N. J.	Clay, shale, sand, gravel	Driven pipes	51	4.5	190
4	New York, Bronx District.	Clay, gravelly, stony	Stand pipes—b	17	6.0	45
5	Providence, R. I.	Gravel, sand, a little clay and loam	Driven pipes	996	30.0	2700
6	New Haven, Conn.	Gravel, sand, some clay	Driven pipes	23	15.0	920
7	Boston, Mass.	Gravel, sand, clay	Driven pipes	548	7.0	2250
8	Philadelphia, Pa.	Clay, marsh, stony	Driven pipes	133	5.8	1400
9	Scranton, Pa.	Gravel, clay, stones	Driven pipes	162	19.0	490
10	Omaha, Neb.	Yellow clay	Driven pipes and hydro grounds	22	3.5	60
11	Denver, Colo.	Clay, gravel, sand	Driven pipes	60	7.0	210
12	Colorado Springs, Colo.	Sand, gravel, adobe	Driven pipes	92	13.0	350
13	Pueblo, Colo.	Sand, adobe, stones	Driven pipes	35	3.5	210
14	Leadville, Colo.	Stones, sand	Coils wire in coke	66	25.0	200
15	Salt Lake City, Utah	Gravel, sand, stones, clay	Driven pipes	61	5.5	210
16	Butte, Mont.	Sand, gravel, stones, clay	Coils of wire	112	17.0	380
17	Helena, Mont.	Sand, stones, clay	Driven pipes	90	21.0	205
18	Moorhead, Minn.	Black loam over clay	Pipes and cones	28	7.0	90
19	Minneapolis, Minn.	Gravel, sand, clay, stones	Driven pipes	114	7.0	490
20	Des Moines, Iowa	Clay	Driven pipes	11	6.0	28
21	Davenport, Iowa	Clay and loam	Driven pipes	11	5.5	25
22	Peoria, Ill.	Gravel, sand, clay	Driven pipes	40	9.0	70
23	Chicago, Ill.	Clay, sand	Driven pipes	19	7.0	43
24	Milwaukee, Wis.	Clay, gravel, sand	Driven pipes	40	15.0	85
25	Indianapolis, Ind.	Clay and gravel	Driven pipes	61	13.0	150
26	Cincinnati, Ohio	Sand, clay, stones	Driven pipes	39	11.0	209
27	Dayton, Ohio	Sand, gravel, clay, stones	Driven pipes	50	13.0	115
28	Toledo, Ohio	Clay	Driven pipes	10	8.0	12
29	Cleveland, Ohio	Clay, shale, sand, stones	Coils of wire in coke	99	19.0	275
30	Canton, Ohio	Clay, gravel, sand	Driven pipes	133	40.0	300
31	Detroit, Mich.	Clay, sand, loam	Driven pipes	15	3.9	68
32	Pittsburgh, Pa.	Clay, shale, sand, stones	Driven pipes	43	15.0	190
33	Washington, D. C.	Clay, stones	Pipes, steel poles	40	4.0	110

Notes—a. One abnormally high value omitted from this average. b. Three and four-inch pipes running under curb to building.

moisture content of the soil, the effect of frost, and the resistivity of the soil. The two former items can be determined only by making resistance measurements on earth connections over a long period of time. The latter is easily studied in the laboratory. It is necessary to study these factors in each locality because they vary to a great extent from place to place.

Data of the Resistance of Artificial Grounds in Different Cities.

Field measurements of the resistance of artificial grounds were made by the Bureau of Standards in the cities enumerated in Table 1, during the months of September, October and November, 1916. In each city, the number of grounds tested ranged from 6 to 40, depending upon whether the soil was uniform or variable. Where the soil was uniform the number tested ranged from 6 to 15, and where it was variable, from 20 to 40. An effort was made to reach all of the different kinds of soil in each place, and also places where extraordinary conditions as to dryness or dampness existed if any were known.

Nearly all of the measurements were made by the bridge method, using alternating current, which has been checked by the Bureau against the ammeter-voltmeter method on several occasions and found to be quite satisfactory for field work as far as accuracy is concerned. As test grounds or reference electrodes, water pipes and bonded street-car rails were used almost exclusively. The resistance of these test grounds being very low, much less than one ohm in nearly all cases, is neglected. That is, the results given below include the resistance of the test electrode, which in all but a few instances is less than one per cent of the resistance of the ground connection upon which the measurement was made.

Table 1 gives in the first column the various cities visited in the course of the work. These cities were selected from a large number in which it was known that artificial grounds were in use, and an attempt was made to include points in some of the New England states, the Middle Western states, and the Rocky Mountain states. The second column gives the general character of the soil in each place. This was usually ascertained by looking at cut banks and excavations nearby, and assuming that what was seen fairly represented the soil where the grounds were made. The third column gives the type of ground most generally used. The fourth column gives the average of all the measurements made in each place, omitting, in the first line, an abnormally high value of 800 ohms, which does not seem to be at all representative of the locality where it was found. The fifth and sixth columns give the minimum and maximum resistances, respectively. These values in many cases at least, represent extraordinary conditions as to dampness or dryness, or of salts in the soil.

The column giving the average resistances is the most important, and here it is found that in only 9 cities out of 33, is it practicable to obtain average resistances for single artificial grounds of less than 25 ohms. In eight of them the average is more than 100 ohms. And it should be remarked here that nearly all of the grounds tested were made with pipes ranging from 6 to 15 feet in length and from one-half to two inches in internal diameter, or their equivalent, practically, in the form of coils of wire in coke. In but three or four cases was the character of the grounds as to dimensions found open to criticism.

Table 2 gives the average resistance by kinds of soil. The soils are grouped as they are in column two because it was found that electrodes embedded in clay, shale, adobe, gumbo, loam and loam intermixed with a small amount of sand showed resistance covering about the same range of values. The minimum and maximum values were usually found under some extraordinary conditions of dryness or dampness and indicate no more than the wide variation due to differences in moisture content, which may be anticipated in soils of the same nature as far as resistivity is concerned. It should be stated, however, that the differences in this case are due to local conditions rather than to widespread changes during the period in which the measurements were made, such as would ensue from rainfall. With regard to rainfall, it is shown by Weather Bureau reports that in about half of the places visited, the precipitation had been slightly above normal for the month preceding the date of making measurements, while in the rest it had been below, so the averages in Table 2 are about what they would be ordinarily for the autumn months. This has been shown by tests at the Bureau of Standards to be about half-way between the minimum, occurring in midsummer, and the maximum, occurring in midwinter.

TABLE 2.—RESISTANCE BY KINDS OF SOIL.

Number of Grounds Tested.	Soil.	Average Resistance.	Minimum Resistance.	Maximum Resistance.
24	Fills, and ground containing more or less refuse such as ashes, cinders, and brine waste	14	3.5	41
205	Clay, shale, adobe, gumbo loam and slightly sandy loam with no stones or gravel	24	2.0	93
237	Clay, adobe, gumbo and loam mixed with varying proportions of sand, gravel and stones	93	6.0	800
72	Gravel, sand or stones with little or no clay or loam	554	35	2700
538				

The chief conclusion to be drawn from the results given in Table 2 is that, unless a ground connection is made in soil containing little or no sand, gravel or stones, its protective value is likely to be very small. The greater the proportions of stones, gravel and sand, the greater the resistance, and in places where there is almost no clay or loam of some form, but all gravel and stones, protection by grounds made with electrodes of limited extent, such as driven pipes, is out of the question.

The seasonal variation of the resistance of ground connections has been ascertained for the climatic and soil conditions in the District of Columbia, and found to be about 50 per cent, the minimum, as stated above, occurring in midsummer and the maximum in midwinter. The soil here is mainly clay and stones; is usually moist, and seldom freezes to a depth of more than a few inches. In sandy and gravelly regions, on the other hand, and where there is deep frost in winter, the variations may be as much as several hundred per cent.

In view of the high resistances shown by artificial grounds in all but a few localities where conditions are favorable to their use, and also their great variability of resistance in nearly all places, it appears to the Bureau of Standards that where such grounds are in use it is to be considered bad practice:

(1) To connect any noncurrent-carrying part of electrical equipment to a circuit ground wire;

(2) To connect any noncurrent-carrying part of an electrical fixture to the grounded wire of a circuit, or,

(3) To run bare grounded conductors in places accessible to persons.

Under heads (1) and (2), if connections are made as it is there stated that they should not be, there is a possibility that dangerous potential differences may exist between the noncurrent-carrying parts of electrical equipment or fixtures (normally exposed and supposed to be at ground potential) and ground, due, not to grounds in the equipment or fixtures themselves, but to crosses with high-voltage lines and the inability of the circuit grounds to provide proper protection, which can probably be avoided by making separate grounds for the equipment or fixtures. Under head (3), if bare grounded conductors are run in places accessible to persons, the same possibility exists, and such conductors should be guarded by insulation, or be made inaccessible.

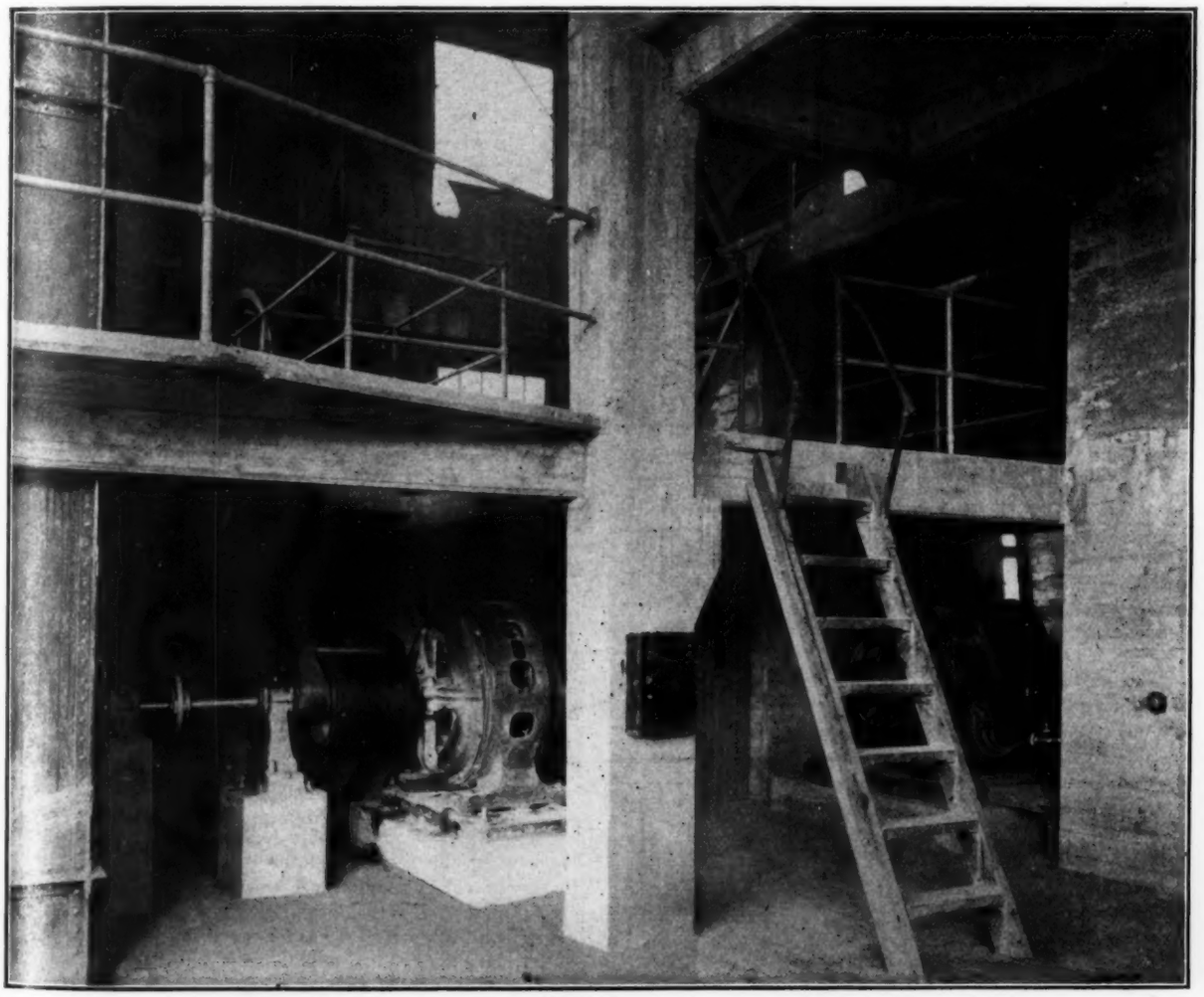
A Completely Electrified Cement Plant

Plant Of the Oregon Portland Cement Company Embodies Many Unique Features—Minimum Number Of Employees Is Required—Central-Station Service Used Throughout

THE extent to which electricity is used in the manufacture of cement is well exemplified in the plant of the Oregon Portland Cement Company, at Oswego, Ore. This plant is completely electrified.

Power for operating the plant is purchased from the Portland Railway, Light & Power Company on a basis of maximum demand for a 20-minute peak. It is received from the company's transmission line at three-phase, 60 cycles, 57,000 volts through a three-pole air-break, 60,000-volt switch mounted on a two-pole structure eight feet from the rear of the substation wall. The power enters the substation through aluminum, outdoor-type choke coils, and Locke high-voltage roof insulators, to a high-tension bus suspended by disk insulators from the concrete roof slab. The high-tension bus and all the 57,000-volt wiring consists of 0.5-inch galvanized conduit instead of copper tubing, greatly reducing the cost of insulation. All joints in the conduit were cleaned with gasoline, and the couplings sweated to the pipe, insuring as good conductivity as the pipe, which has sufficient carrying capacity for the high-tension current. Taps are taken off this bus to three single-pole knife switches leading to high-tension series relays mounted vertically on insulators. The low-voltage relays are mounted horizontally on a six-inch channel and are operated by means of Micarta insulating links. The links are 66 inches long, but the channel is provided with adjusting screws to regulate the exact length of the links for tripping. These relays have inverse-time limits operated by bellows, which prevent them from short-circuiting the magnet coil employed for keeping a 60,000-volt oil circuit-breaker in closed position. The magnet coil also has a snap switch on the back of the board in its circuit, to enable the operator to trip the switch from the board when desired.

Disconnecting switches mounted on the back of the same structural-steel framework over the circuit-breaker, which supports the relays, connect to a transfer bus suspended from the roof. From this taps are taken to two three-phase 1000-kilovolt-ampere water-cooled transformers. These transformers step down the current from 57,000 to 480 volts. They are Y-connected with grounded neutral and have four high-tension taps. Only one transformer is used at a time,

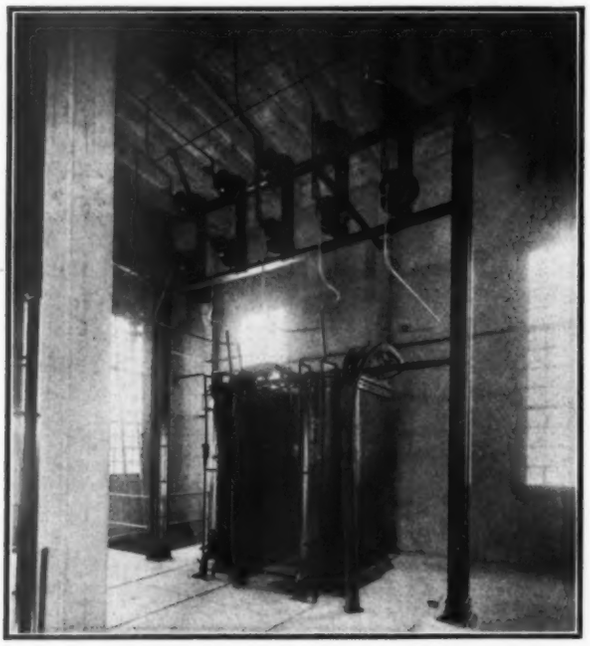


Two 150-Horsepower Squirrel-cage Induction Motors Driving Komminuters, Lenix Drive.

the other being held as an emergency spare and disconnected from the line on both sides.

The power leaves the transformer through cables which drop through fiber bushings into the basement and pass through a novel type of disconnecting switch, consisting of two three-pole, 1500-ampere, unfused knife switches with quick-break clips, mounted face to face in the ends of a steel cabinet supported on a concrete slab, which in turn is on piers about five feet from the floor. The bottom of the switches are tied together with heavy copper straps, and the busbar copper rises vertically from the middle of this through slate-protected openings in the top. The main busbars then pass horizontally under the floor beams, through the floor, and directly to the switchboard distribution busbars.

Cable-type current transformers are mounted on the vertical rise of the busbar on an iron frame which supports both the power company's and the cement company's transformers. The secondary leads are taken in conduit through the floor and directly to the bottom of the totalling panel on the switchboard. Potential transformers for operating the control circuit of the curve-drawing wattmeters are mounted under the floor slab in the basement, directly below the switchboard.



Transformers, Disconnecting Switches and High-Tension Bus.

On account of inability to procure solid busbar copper in Portland or vicinity, the expedient of taping together 20 No. 1 solid bare copper wires into a busbar was adopted, connecting same at all angles with red brass castings having the wires securely soldered in.

The substation is protected by a bank of four tank electrolytic aluminum-cell lightning arresters, mounted inside the station, but with horn gaps and transfer switch on the roof. These arresters are charged three times a day. A unique feature of the substation is that a private telephone system is installed for communicating directly with the load dispatcher in Portland.

The lightning load is handled by two 10-kilowatt 440-110-volt transformers in open delta in the basement, connected to 10 single-pole knife switches, mounted on the lighting panel, each switch controlling one department in the plant.

Switchboard.

The switchboard is divided into nine panels. Natural black slate is used, and the oil switches are mounted on a framework and operated by bell cranks, with levers under the floor, leaving a clear passage behind the board. Single-pole unfused knife switches are mounted between the busbars and the oil switch on each panel, so that each department of the plant can be cut clear of the board without disturbing any of the remaining circuits. Current transformers on the two outside legs of each circuit are used for the indicating and integrating wattmeters on each panel, and by means of these instruments a record is kept each day. The totalling panel has the following instruments mounted on it: an ammeter with a 3000-ampere scale, and ammeter for measuring all three phases, indicating wattmeter, a power-factor meter, a voltmeter, a Bristol recording voltmeter, and two curve-drawing wattmeters, one belonging to the power company, the other to the cement company, one meter checking against the other. The power company also has an integrating wattmeter mounted on the back of the board.

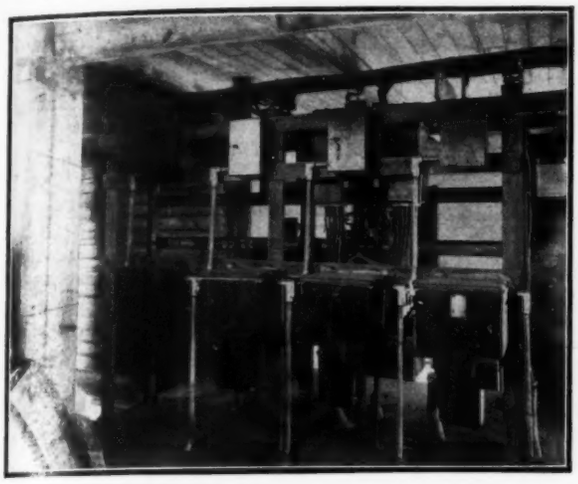
Distribution of Power.

The entire distribution system is underground, a main cable tunnel running the entire length of the plant and taken off to the various departments. All power and lighting cables pass directly from the switchboard into a cable tunnel, which runs in the form of a "T" for 300 feet. The heavy power feeders, varying from 400,000 to 1,000,000 circular mils, are carried on insulators, supported by galvanized-iron-pipe frames, built into the concrete walls of the tunnel, which is waterproof, and is 5 feet wide by 5 feet high. All remaining power and lighting circuits are in conduit carried by the pipe frames, the entire system insuring absolute safety against interruption of service. All service taps are taken off in conduit, buried in the concrete directly to the distributing compressor structure in each department.

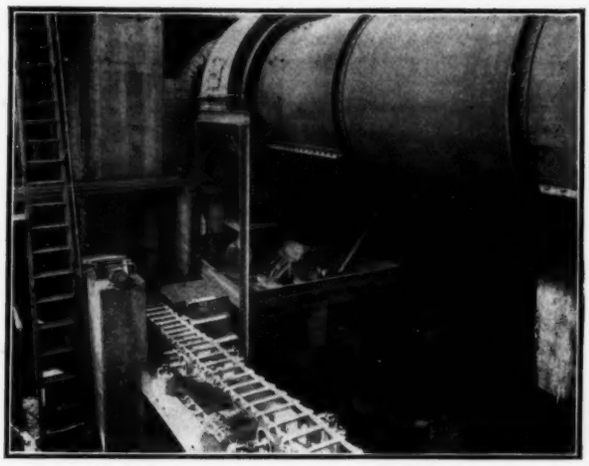
A 250-Horsepower Induction Motor Driving No. 18 Tube Mill. Distance Between Centers Is Only 7 Feet.

Each department of the plant has all starting compensators assembled together on a structural-steel frame from which the various motor circuits radiate in conduit. Dustproof compensators were used throughout, having conduit entrance and outlet bushings. Each compensator is provided with an ammeter for all sizes above 75 horsepower.

The main circuit from the cable tunnel forms a busbar running horizontally above the system, from which taps are taken through three-pole knife switches in steel cabinets,



Centralized Control in Raw Grinding Department.



View of Cooler and Conveying Machinery Located Immediately Under Kiln.

whose functions are to disconnect each motor for repairs, or when not in service.

A novel feature of the installation is that every motor has a 600-volt snap switch located directly at the motor, and connected to the low-voltage release coil of the compensator by No. 14 duplex cable, so that the operator can open this circuit and shut down the motor, without taking time to go to the board, in case of emergency. This system of concentrated control permits one operator to stop or start some 700 horsepower in motors without moving more than 10 feet, and in a very short time.

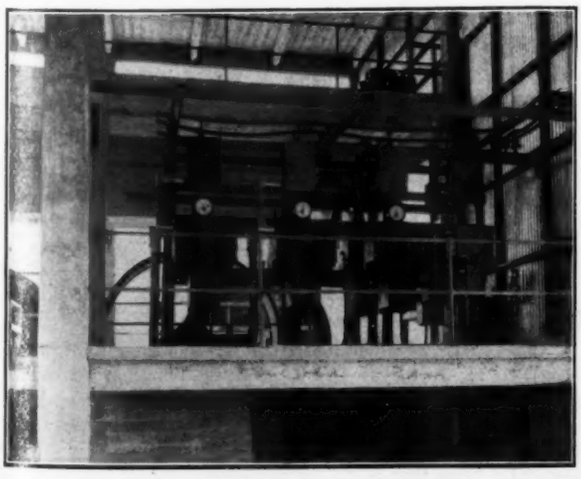
Process of Manufacture and Motor Equipment.

In the manufacture of this cement two kinds of rock are used; lime rock from Roseburg, Ore., running about 96 per cent. $CaCO_3$, and a cement rock from Dallas, Ore., running about 60 per cent. This rock is first fed to a 7.5 Austin gyratory crusher, driven by a 75-horsepower squirrel-cage induction motor. It is then elevated and stored in 10 circular reinforced-concrete storage bins, 69 feet high and 22 feet in diameter with 6-inch walls. These bins hold 12,000 tons. From the bins the rock is elevated by a belt conveyor and discharged into feed bins over the comminuter. In this mill, which is driven by a 150-horsepower motor with Lenix drive, the proportioning of the two rocks is done by two automatic feeders discharging into the comminuter, into which a stream of water is also fed.

The final grinding is done in two tube mills, using small steel cylpebs and driven by 200-horsepower motors with Lenix drives. These mills take their feed from a reinforced-concrete feed trough built as a unit with the floor beams, and which has an agitating shaft and paddles.

Three circular correcting basins 24 feet in diameter permit the chemist to vary his feed until he gets 76.6 per cent $CaCO_3$ when mixed in the agitating basin below. An Ingersoll-Rand air-lift pumping system is used for pumping the slurry over to a 2000-barrel reinforced-concrete storage basin under the kiln. This basin is built part above the ground and part below. It is 26 feet deep, and the kiln piers are part of the structure. The plant is unique in that pumps have been discarded for pumping slurry to the kiln; a double reinforced-concrete continuous bucket elevator is used. The slurry stands at the same level in the elevator as in the basin, and exerts a great pressure on the walls. This elevator has proven very economical, as it requires very little attention and is much cleaner than pumps.

A mechanical feeder lifts out a definite amount of slurry at each revolution and feeds it into the rotary kiln, which is 210 feet long by 9 feet and 10 feet in diameter, being the largest kiln on the Pacific coast. It rests on five tires and weighs about 500 tons. It is driven by a 75-horsepower variable-speed motor, located under the burners control. Crude oil is used, with air at two pounds pressure for atomizing. The kiln is rated at 1000 barrels, but, as previously stated, easily produces 1200 barrels a day, and requires only two men to operate it on each shift.



View of Centralized Control in Finishing Department.

Interior of Substation, Showing Switchboard and Bus Structure.

The clinker is cooled by a Smidth horizontal pressure cooler, using a blast of air from a 12-foot pressure fan. Another novelty in this plant is the method of handling the clinker, using No. 480 drag conveyor chain in a cast-iron lined, reinforced-concrete trough, and discharging into a reinforced-concrete elevator leg from which a belt conveyor takes it to circular storage bins, holding 6,600 barrels each. In this manner, as soon as the clinker is ground fine enough, it becomes the finished cement. A comminuter and a 22-foot tube mill in the grinding department grinds 1,200 barrels per day with two men on each shift of 12 hours each. The comminuter is driven by a 150-horsepower motor with Lenix drive. The tube mill is driven by a 250-horsepower motor with Lenix drive. While the use of Lenix drive is not new, this is a rather noticeable installation in that the motor drives the tube mill through a 24-inch belt with only a seven-foot distance from center line of driving pulley to center line of driven pulley. This is very excellently illustrated.

From the storage bins, which are of reinforced-concrete, the cement is drawn off and packed into sacks as required.

On June 1, 1916, the Oregon Portland Cement Company made the first barrel of cement ever manufactured in Oregon. The plant is located approximately eight miles south of Portland on the Southern Pacific Railway, and on the banks of the Willamette River, thus affording alternative transportation of the finished product. In the equipping of the plant all the most modern features of cement manufacture have been adopted and every effort made to secure a dustless plant. That it is a real dustproof plant can be appreciated when it is stated that the illustrations which are here reproduced were photographed at the plant when it was running full blast.

The entire construction is of reinforced concrete, even including the roofs, practically eliminating depreciation and fire hazard. Due to the economical layout of the plant only 40 men are required to operate it, which is considerably below the average number required for the ordinary 1000-barrel plant. Furthermore, while this is normally a 1000-barrel plant, 1200 barrels a day are being steadily turned out, and sometimes as many as 1300 barrels. Another feature is that one barrel of cement is obtained for each 8.4 gallons of crude oil, which is considerably below the average.

REDUCTION IN COST OF ELECTRIC LIGHTING GRAPHICALLY SHOWN.

Simple Chart To Show Reduction in Lamp and Energy Costs and the Increasing Amount of Light Obtained From One Cent.

One of the strong talking points of the electric lighting salesman, when he is required to show economy, is the steady reduction in both the cost of electrical energy and the cost of electric lamps, which together have resulted in a very marked and quite steadily rising increase in the amount of light obtainable for a dollar or a cent, whichever unit is chosen. Such curves have been used in the publicity work of various central stations as well as lamp and fixture-equipment companies, but probably have never been shown as a complete and self-contained set of curves as that illustrated herewith. It has been prepared by the National Lamp Works of General Electric Company, Cleveland, O.

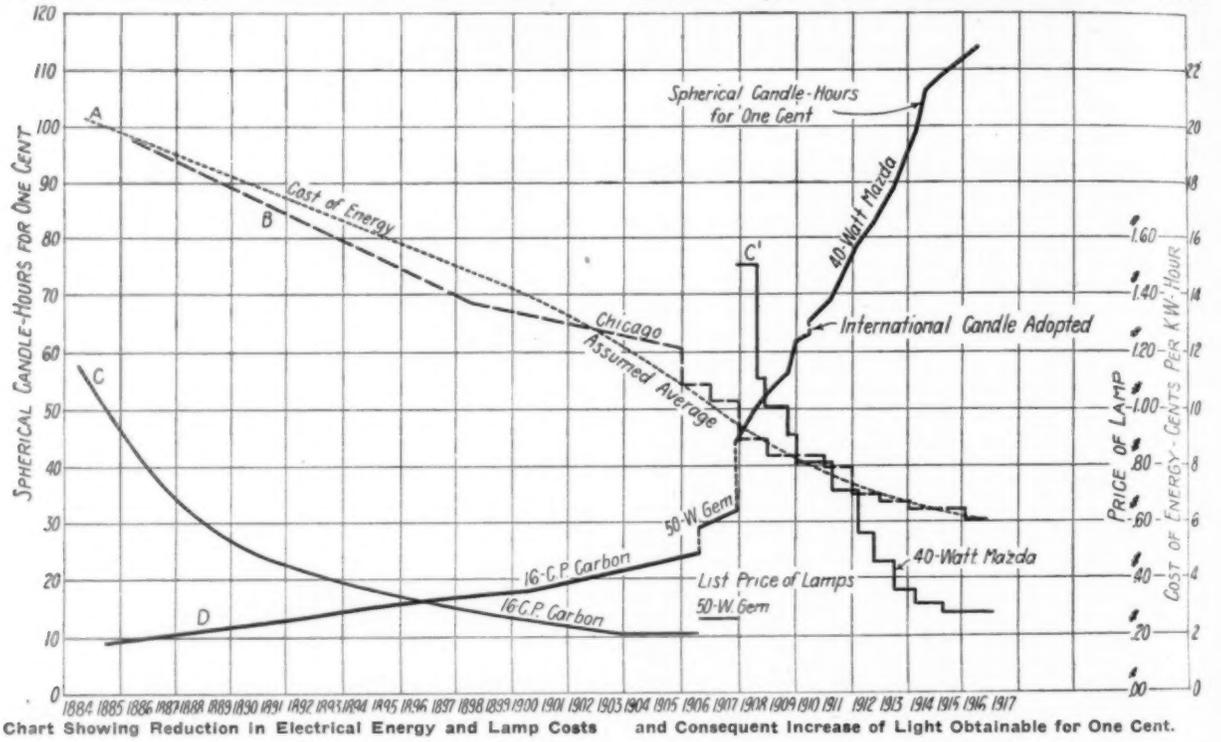

Spherical Candle-Hours for One Cent
Cost of Energy
Chicago Assumed Average
40-Watt Mazda
International Candle Adopted
50-W. Gem
16-C.P. Carbon
List Price of Lamps
50-W. Gem
40-Watt Mazda
16-C.P. Carbon
A
B
C
C'
D
Spherical Candle-Hours for One Cent
Price of Lamp
Cost of Energy - Cents per K.W. Hour
1884 1885 1886 1887 1888 1889 1890 1891 1892 1893 1894 1895 1896 1897 1898 1899 1900 1901 1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917

Chart Showing Reduction in Electrical Energy and Lamp Costs and Consequent Increase of Light Obtainable for One Cent.

This chart is described as a photostat or composition curve, which shows at a glance valuable data that otherwise would require numerous and rather intricate tables. Curve *A* shows the cost of energy plotted in cents per kilowatt-hour according to scale shown at the extreme right end of the sheet. In curve *B* the same data are given for the special conditions obtaining in the city of Chicago. Curve *C* shows the changes in list price of lamps, which have been considered as standards. Between 1907 and 1908 there is a break in the curve, due to a change from the use of the 50-watt Gem lamps, common to that time to the 40-watt Mazda lamps, which replace the older units. The portion of the curve covering the use of the Mazda lamps has therefore been specially labeled as curve *C'*. It really is an extension of the broken curve *C*.

The curve obtained based on these two curves is the heavy curve shown as *D*. This gives the spherical candle-power-hours obtained for one cent, in accordance with the scale at the left edge of the sheet. The spherical candle-hours available are based on the cost of operation of the particular lamp that might be considered standard during the corresponding year.

Notes on Commercial Practice

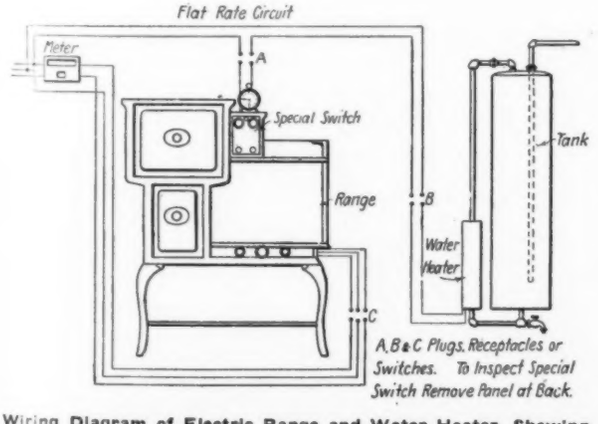
New-Business Methods, Policies, Rates and Kindred Central Station Matters for the Man Engaged in Selling Electricity

ELECTRIC-COOKING PROGRESS IN SPOKANE.

Washington Water Power Company Has Sold 400 Ranges and 400 Water Heaters During the Past Five Months—New Campaign Started.

During the first five months of 1917 the Washington Water Power Company has sold 400 electric ranges in Spokane and vicinity and the "busy season" for electric cooking has just started. In practically all cases the electric range replaced a gas, gasoline or coal range. Equal success is being achieved in the introduction of the electric water heater, about 400 of these having been disposed of since the first of the year.

The Washington Water Power Company has been selling electric ranges since 1912, but only within the last few years has the sale on a large scale developed. The stock of ranges has been reduced to the point where only three standard maks of ranges are supplied to consumers, the idea being to keep the variety as small as possible, thereby making stock problems simpler. It has been found that in order to make the volume of sales greater, something of a campaign nature was necessary, both to encourage the salesmen and to appeal to the purchaser. In previous years when the ranges were first being introduced public demonstrations, lectures and similar methods were adopted in popularizing the ranges in the early stages. In these latter years, however, it has become a matter of closing with individual customers whose interest was already aroused. For this purpose the company is now carrying on a campaign with the idea of capitalizing the desire of the average woman to take advantage of a bargain, and at the same time conduct a campaign that must not necessarily close on a definite date, and thereby hold up



Wiring Diagram of Electric Range and Water Heater, Showing Arrangement to Prevent Use of Both at Same Time.

a large number of sales until the last day with its attendant rush.

The principle of the present campaign is to give a discount to the first purchaser of an electric range in any city block in Spokane. The residential lighting customers of blocks in which there are at present no electric ranges are circularized by letter the week previous to that in which the salesmen will put their intensive efforts upon a given district. The letter does not specify prices but merely the fact that the consumer will be given advantage of terms and prices equal to those given the company's own employees and the suggestion is made that the consumer telephone for an appointment with a salesman. This method makes it possible for a separate campaign to be conducted in each city block, pitting one customer against the other as to which will buy a range first. The results to date are proving very satisfactory.

In order to make it possible to sell additional ranges it is found necessary that ranges already sold be given the greatest attention and the consumer is not considered sold until an expression of satisfaction has been secured from her. For this purpose a routing sheet is used which is kept in a live file until a report by the home economist, employed by the company, who visits the customer in order to instruct her in the proper use of the range, shows that the consumer is satisfied.

Large demonstrations are found to be no longer necessary and the only demonstrations are those conducted in the company's own electric kitchen or in the range-display room of the company, or in the customer's own home after a range has been placed in service. It is not found necessary to sell ranges on approval, but ranges are sold with the guarantee that they will be satisfactory.

The problem of water heating has received special attention in this territory as it is found impossible to make a consumer's kitchen electric in the fullest sense unless the coal or gas range is removed. For this purpose a circulating water heater on a flat rate is used to heat the water in the range boiler. This boiler is lagged to prevent excessive radiation. In order to prevent the water heater from coming on the range peak, it is placed on a double-throw switch which prevents the heater being used simultaneously with the range oven. The water heater circuit is wired ahead of the meter, a special switch controlling it. The flat rate on this style of water heater is $3 per kilowatt-month and it has been found that 60 per cent of the ranges to date have been so equipped, the consumer frequently finding the water heater a source of even greater satisfaction than the range. Wiring diagram for range and heater is shown herewith.

Results of Spring Housewiring Campaign at Byllesby Properties.

Sixteen Byllesby electric properties conducted campaigns for the wiring of already-built houses between April 15 and June 1, with the results noted below from the ten properties making final reports.

Awards of original hand-painted posters will be made to the properties making the best showings per 1,000 of population.

Property	Contracts Secured	Property	Contracts Secured
Fargo	47	Minneapolis	704
Grand Forks	50	San Diego	71
Stockton	51	Fort Smith	131
Faribault	34	Muskogee	50
Ottumwa	200	Sapulpa	30

ALLENTOWN COMPANY SECURES IMPORTANT CONTRACTS.

South Bethlehem Pumping Station and Several Large Industrial Plants Among New Business Signed, Aggregating 16,450 Horsepower.

The Lehigh Valley Light & Power Company, Allentown, Pa., has just recently started work on several large power installations, one of which, the electrification of the steam pumping station of the Bethlehem City Water Company at South Bethlehem, represents one of the most complete and modern pumping installations of its kind in the state.

The pumping station of the Bethlehem City Water Company is located along the Lehigh River just outside of the Borough of Bethlehem, and at the present time water is pumped by means of large flywheel-type reciprocating steam pumps from the Lehigh River through a suction of approximately 22 feet, then through the pumps and up over the hill, a lift of 280 feet to the filter beds and large reservoir located on the crest of the hill near the St. Luke hospital.

The new pump which is being installed will replace the present steam pumps and will be of ten million gallons per 24-hour capacity. This pump is a centrifugal pump made up of two 5,000,000-gallon units in series, direct connected to a 700-horsepower, three-phase, 2200-volt, 60-cycle motor. This type of pumping unit represents the best modern practice in every detail and the installation is complete with the most improved protective devices and the most modern switchboard equipment so as to make as reliable and efficient a unit as possible. For the same amount of pumping duty the ratio of the unit sizes of the turbine as compared with the old fly wheel type of pump is about one to eight, showing this great advantage of this type of pump compared with the earlier flywheel type. Beside the economy of space, the efficiency of this type of unit is also much greater than the flywheel pump.

CEMENT COMPANY TO TAKE 12,500 HORSEPOWER.

Another large power installation which this same company also has under construction is the 900-horsepower electrification at the Ormrod plant of the Lehigh Portland Cement Company, between Allentown and Slatington. This electrification only represents a very small part of the total of this plant of the Lehigh Portland Cement Company, but the plans for the future contemplate the complete electrification of this entire plant and when completed will represent one of the largest electric power developments in the cement industry. Work has already been started on the construction of a 13,000-volt high-tension line from the Siegersville substation of the Lehigh Valley Light & Power Company, and it is expected that the operations will be completed and the substation in operation by the first of September, 1917.

PHOENIX SILK MILL TO USE 800 HORSEPOWER.

In addition to the above two electrifications, the Phoenix Silk Company, of Allentown, has just completed the installation of electric motors to drive its entire ribbon mill, and is starting work on the change over of the large broad silk plant. These two silk mills will be completed in a very short time and will be the largest silk mill electrification in this district of the silk industry. A number of other silk mills in the territory are at the present time abandoning their steam-plants and installing electric motors, the total load being 1450 horsepower.

BRICK YARD BUYS POWER.

The large plant of the Lehigh Brick Works, just south of Allentown, is rapidly nearly completion, and the installation of over 400 horsepower in motors at this plant is about to be cut in on the lines of this company. This brick plant will have a capacity of 50,000 bricks per day and will be one of the most modern and scientifically equipped brick plants in the country.

The National Slag Company, at Hokendauqua, and the Emanuel Slag Company, at Catasauqua, and the Kurtz Furniture Company, at Fullerton, with a total of approximately 600 horsepower, are just being completed and will also be cut in on the lines of the Lehigh Valley Light & Power Company within the next month.

New York Edison Company Has a Record Week in New Contracts.

One week's new business recently secured by the wholesale bureau of the New York Edison Company reached a total of 1802 horsepower and 28,640 lights, representing an aggregate of 55,670 50-watt equivalents. Included in these were contracts for five new buildings, the installations of which consisted of 9000 incandescents and 440 horsepower of 15,600 50-watt equivalents. Three private plants were closed down with an installation of 6520 incandescents and 220 horsepower, the equivalent of 9820 50-watt lamps. These and the seven remaining contracts totaled 55,670 50-watt equivalents.

Large Buildings Adopt Edison Service
During the past seven years, Central Station service, for light and power, has been adopted in more than 97% of all of the new buildings erected on Manhattan Island. The exact percentage for this period is as follows
1916 . . . . 98.2%
1915 . . . . 98.8%
1914 . . . . 97.1%
1913 . . . . 96.9%
1912 . . . . 97.3%
1911 . . . . 96.8%
1910 . . . . 97.1%
Several of the largest buildings of the City have abandoned their hydraulic elevators and high pressure steam, substituting convenient and efficient electric elevators and auxiliaries and low pressure steam, with large saving in cost. Thus may an old structure become modernized, large operating economies are secured and the coal problem is eliminated
That which is desirable for new buildings is necessary for old buildings. This Company is prepared to furnish accurate estimates upon changes of this nature, without cost to the consumer
The New York Edison Company
At Your Service
Irving Place and 15th Street—Stuyvesant 5600
Branch Office Show Rooms for the Convenience of the Public
Address Telephone
424 Broadway Canal 8600
126 Delancey Street Orchard 1960
10 Irving Place Stuyvesant 5600
124 West 42d Street Bryant 5262
Address Telephone
151 East 86th Street Lenox 7780
25 East 125th Street Harlem 4000
362 East 149th Street Melrose 9900
Night and Emergency Call: Farragut 3000
All Show Rooms open until midnight

A Newspaper Advertisement Used in Campaign to Secure Office Buildings.

Hot Springs Company in "Business Must Go On" Campaign.

In a full-page advertisement in the local daily papers, the Citizens Electric Company and allied utilities of Hot Springs, Ark., make a plea for a continuation of business as in normal times and warn against needless retrenchment.

"Keep business normal by being normal yourself. Money is going to be made in this country during the war and nothing has happened to change the truthful quality of the old saying that 'Fortune favors the bold,'" says the advertisement.

New Electric-Furnace on Central-Station Service.

On May 25, furnace No. 3 of the Wharton Steel Company, Dover, N. J., was blown in, having a capacity of 500 tons per day. This is the second furnace that has been blown in since the Replogle interests have taken hold of these properties. Furnace No. 1, with a capacity of 125 tons was blown in April 12. It is expected to have Furnace No. 2 completed and blown in about June 15. It also has a capacity of 500 tons. The blowing in of these furnaces will make a capacity of 1,125 tons per day, employing in the neighborhood of 800 men. This means the opening of all the mines in this immediate vicinity that are controlled by the same interests, thereby creating a demand for electricity to operate their pumps and crushers. Energy is supplied by the New Jersey Power & Light Company, of Dover.

Garden Light for Night Work in New Orleans.

A circular letter from the Secretary of Commerce, which was published recently in all the daily papers, urging greater production of foodstuffs, particularly in the "back-yard" garden, suggested to the New Orleans (La.) Railway & Light Company that if some way could be devised to make it possible for men to work at their gardens in the evening, it would accomplish a whole lot toward stimulating back-yard gardens in the city and appeal to many who wished to do their bit that way. It was decided therefore to devise some way, if possible, to put the suggestion into practical form and provide some kind of a garden light so that any customer of the company could devote a few hours in the evening to his patriotic duty of raising his share of the food now needed so badly. Commercial Manager Clement soon hit upon the answer and devised a long pointed pole equipped at the top with a lamp and reflector to throw the light downward and provided with an attachment extension cord that can be plugged into an outlet in the house or garage. This pole can be easily stuck into the soft soil of the garden and will stand at any angle desired. Several of these are now installed.

Boston Edison Company Discontinues Periodic Lamp Exchange.

The Edison Electric Illuminating Company, of Boston, has notified its customers that, owing to the present national conditions, its system of periodic calling for the exchange of incandescent lamps will be discontinued from June 1.

Old lamps may be exchanged at the nearest renewal office for new lamps on the usual terms and it is recommended

City or Town ..... Date 191

Street .....

Name .....

PLEASE DELIVER THE FOLLOWING INCANDESCENT LAMPS FOR RENEWAL:

Number	Size Watts	Plain-Frosted or Colored	Type Carbon or Mazda	Style of Bulb PEAR, TUBULAR or SPHERICAL

Remarks .....

P 99

Post Card Sent to Boston Edison Customers for Their Convenience in Ordering Lamps.

that customers make their exchanges at these offices so far as possible.

Orders may also be given by telephone to the nearest lamp renewal office or to the main office, although written orders definitely stating number, size and type of lamps desired are preferred so far as convenient. The accompanying illustration shows a post card sent to customers for use in this connection.

Orders placed by telephone or mail will be sent usually by special delivery, but in some cases by parcel post or express.

New Orleans Company Conducts Campaign on Labor-Saving Appliances.

An effort is being made by the commercial department of the New Orleans Railway & Light Company to capitalize as far as possible the present conditions in the country which have turned the minds of the people towards thoughts of conservation. A special sewing-machine campaign was started in May, in which the company offered to equip the sewing machine in any home with an electric motor, on the payment of $1.00 down, the balance to be charged on the monthly bills. The electric sewing-machine motor was recommended as a means of increasing the amount of sewing done in the home, offering an opportunity to save expense in purchasing clothes ready-made. This appeal has been very effective.

On the same basis, vacuum cleaners and other labor-saving devices are being suggested from the standpoint of the economy they offer. For, it is believed that it is bound to become more and more difficult to secure servants for the home, and any educational work that can be done along these lines should render a distinct service to the community and prove most profitable to the company. Also, as the initial step in this work, a thorough house-to-house canvass is being made in the city of New Orleans looking to the wiring of such homes as are not yet connected to the circuits, which as secured will provide additional market for appliances.

A very effective display board has just been installed in the salesroom of the New Orleans Railway & Light Company which it is felt is going to be of great assistance in demonstrating lamps, reflectors and fittings. A recording meter mounted in a glass case is conveniently placed to demonstrate the consumption of different size lamps and familiarize the customer with the relative costs of using the various devices.

Suggestions for Selling Illumination Available in Booklet.

The successful salesman is one who sells not the cause of producing good lighting but effect of good lighting. This is the basic idea behind a new merchandising book just issued by the Society for Electrical Development.

The book, the title of which is "Buying a Cause and Paying for an Effect," argues that too many salesmen fail to get the customer's point of view and try to sell their merchandising "on the hoof." They forget that the customer is primarily interested, not in lighting equipment and current, but in such matters as increased profits, cheerfulness, or accident prevention resulting from good and sufficient illumination.

The new bookl t is presented in a style somewhat similar to "How to Sell an Idea," the Society's successful handbook on electric-range selling. Following the development of the main idea—"Selling Illumination"—there is a chapter on "How to Sell," and another showing photographs of well-lighted shop-windows, as well as one on "Factory Illumination." The book concludes with a complete bibliography listing the various books and articles which have been published in the industry on the subject of good lighting.

The first edition of "Buying a Cause and Paying for an Effect," numbers 5000, and has been mailed to the Society's entire membership.

INDUSTRIAL ELECTRIC TRUCK EFFECTS ECONOMIES.

Many Freight Houses and Factories Relieve Congestion by Use of Tractors.

In these times of forced production and limited shipping facilities the storage-battery tractor is demonstrating its efficiency and its use is being rapidly extended to manufacturing plants and freight houses where the problem of congestion is a serious one. The accompanying illustration shows an electric tractor in use in a Chicago freight station and gives a good idea of the utility and flexibility of such a system of transportation.

Electric Tractor Used in Chicago Freight Station.

One of the principal advantages of the electric tractor is the great saving in labor as one man can conveniently handle a train of trailers limited in number only by the capacity of the motor.

The very small turning radius and compactness of the outfit are additional points which recommend it for congested locations.

POSSIBILITIES OF ELECTRIC PUMPING FOR IRRIGATION.

Western Central Stations Obtain Considerable Revenue from This Business—Data on Plants in Spokane District.

The Okanogan Valley Power Company, Brewster, Wash., is operating two hydroelectric power stations, much of the energy produced being used to pump water for irrigation purposes along the Okanogan and Columbia Rivers in north central Washington. One plant is on the Similkameen River, close to Oroville, and the other is on the Methow, near Pateros, where that stream empties into the Columbia. In one typical case, this company supplies power for an orchard company to pump water to cover a tract of 1000 acres on the Okanogan River, between Bridgeport and Brewster. The pump station for this work consists of a 150-horsepower motor, connected to centrifugal pumps which raise 7000 to 10,000 gallons of water per minute against heads of 45 and 55 feet, discharging into open ditches.

The electric power charge for this service is $7 per horsepower per month, for the four months of the irrigating season, the pumps operating 24 hours per day during that period. Other smaller tracts in that locality are irrigated in a similar manner.

Between Pateros and Bridgeport a number of tracts aggregating about 2000 acres are under irrigation with water pumped to the canals by electric power from the Methow plant. The lift required ranges between 25 and 100 feet. It is figured that the economic lift, under conditions prevailing, is a maximum of 100 feet. The region referred to is far below the government gravity irrigating project on the Okanogan. There are thousands of acres of desirable land along the Columbia and Okanogan, between Pateros and Riverside, where the elevations above the streams do not exceed 100 feet, and the only available method of irrigating is by electric pumping. Numerous small individual pumping plants are in operation wherein the lift runs 25 to 50 feet. This company contemplates building a new and larger plant on the Similkameen River in 1918.

Pumping Plants of Hayden Lake.

Two electric pumping plants on Hayden Lake, 35 miles east of Spokane, have been in operation three to four years. The Hayden Lake Irrigation District owns one of these, and the Post Falls Irrigation District owns the other. The Post Falls district plant contains two 250-horsepower motors, each direct-connected to a Byron Jackson 18-inch turbine pump, having a capacity of 9000 gallons per minute, against a static head of 30 feet. This is the capacity of each pump measured at the discharge end of 25,000 feet of 42-inch wood-stave pipe. In this distance the friction head is about equal to the static head. This discharge is divided—one part going into a 24-inch pipe and the other part into a 16-inch pipe, both being distributing mains. The motors here used operate at 690 revolutions per minute. The Hayden Lake plant has two 100-horsepower motors, each direct-connected to a centrifugal pump of 3000 gallons per minute capacity, operating against a head of 65 feet, at the discharge end of a wood-stave pipe line. In this, as in the other case, the principal supply main delivers into smaller distributing pipes, and the latter into ditches.

Deep-well Pumping in Spokane District.

A system of electric pumping for irrigation, developed on a considerable scale in Spokane valley, is that in which wells are the sources of water supply. Such wells tap the stratum of gravel, the water-level in which is the same as that of the Spokane River and Coeur d'Alene Lake, and it rises or recedes according to high or low water. Most of those wells are bell-shaped and range in depth from 70 to 150 feet.

A brief description of one particular well and its pumping equipment will serve to illustrate many features common to all wells in Opportunity and other districts: This well is circular in shape, 8 feet in diameter from the collar to a depth of 20 feet, from that point down 39 feet lower the walls spread out bell-shaped so that at the bottom, or 59 feet below surface, the diameter is 12 feet. Near the wall a suction shaft, four feet in diameter was sunk 18 feet from this circular bottom into the stratum of gravel. A perforated-iron shell of same length and diameter as the shaft was let down, forming a shaft lining. A Byron Jackson 20-inch pump, of 3500 gallons capacity and a 100-horsepower motor, were installed at the bottom of the well proper, the suction pipe extending down the shaft that taps the water stratum. The pump and motor are set upon a platform supported by iron rails. Normally, about 2750 gallons of water per minute are delivered to the surface and discharged direct into 16-inch mains of reinforced concrete, connecting to distributing pipe lines. The pump station in the well also includes a four-inch, 300-gallon pump, operated by a 15-horsepower motor, whereby water for domestic uses is delivered to the surface and into a 50,000-gallon storage tank. The district owns the well and all pumping and distributing equipment, and buys power from the electric companies. Definite costs for this service were not obtainable.

There are six wells in Opportunity district, 94 to 150 feet deep, and having electric pumping facilities for lifting 3000 to 6000 gallons per minute.

Electrical Construction Notes

A Department Devoted to Problems Relating to the Installation, Operation and Maintenance of Electrical Equipment

Emergency Post for Island Safety Lights in Parks and Boulevards.

In the boulevard systems and driveways of park systems in large cities it has come to be customary to place small, raised, so-called safety islands with red warning

Emergency Island Light for Lincoln Park System, Chicago.

lamps in the middle of the driveway, which serve both to accommodate pedestrians in crossing through congested traffic and to compel drivers to adhere to the rules of the road, especially in making turns. They also serve to warn drivers of crossings at which a large number of pedestrians must be watched for. Occasionally a reckless driver, running his automobile at high speed, will not only fail to heed the evident warning of the island light, but will even run into and upset it. This removes this safety element from a dangerous point and it is desirable that means be provided as quickly as possible for replacing the damaged post by an emergency light.

In the Lincoln Park System in Chicago there is a large mileage in boulevards and park driveways, in which a continuous procession of automobiles is passing. Therefore a considerable number of island lights are provided at important crossings. These are surmounted by a large, red globe in which there are at least two lamps fed from separate sources so that if one should fail the other could still be relied on to give its warning. Accidents of the kind referred to above have happened on Lincoln Park driveways and to meet the emergency C. H. Shepherd, electrical engineer of the Lincoln Park System, has provided special emergency lamps which can be installed in a few minutes after being brought to the crossing point. Three of these are kept on hand at the central power station and office of the electrical department. One of these is shown in the accompanying illustration. This shows the method of installing it in the pocket provided in the concrete base. Connecting plugs are arranged which can be quickly plugged into circuit receptacles in the base.

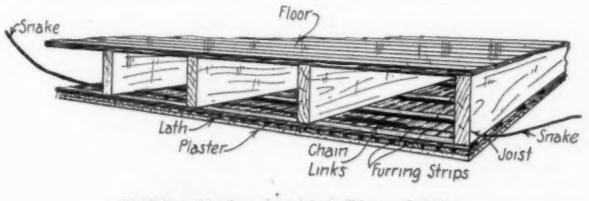
Another interesting feature in the emergency line is that a set of blocks and tackle is also kept at the central power house and a motor truck with derrick can be quickly run to any point of the system to remove any car that has met with an accident and is thereby obstructing traffic. Every provision is made to keep the driveways open.

Fishing Under Studded Floor Joists.

By John Domerhuizen.

In some parts of the country it is customary to nail lath for ceilings to special furring strips that are nailed across the joists, instead of nailing the lath directly to the joist. Where this construction is used it is possible to wire old houses in a fairly inexpensive way with very little removal of flooring or baseboards. The accompanying sketch shows that when fishing loom or BX under the joists in this case considerable labor and time can be saved. Ordinarily it is difficult to pull BX through in this case because when the plaster is applied it projects through the spaces between the laths and curls into uneven projections above them, which are commonly spoken of as "keys." Directly under the beams these keys are likely to choke up the entire space, depending upon the thickness of the furring strips employed. It is, of course, annoying to find that after running a snake through it is impossible to pull the BX or loom into place because the keys compel the end of the BX to curl up and get wedged at the edge of the joist or beam.

To overcome this I have found that it is an excellent plan, after the snake has been fished, to take a piece of chain about 6 or 8 inches long and slightly larger in diameter than the BX, this chain being placed on the end of the snake and the BX tied to it. Now as the chain is drawn through it will bite into the plaster keys and remove enough



Fishing Under Studded Floor Joists.

of the projections to give the required clearance for the BX or loom.

Of course, where lath is nailed directly to the joist this scheme cannot be used and the old method of drilling through joists wherever necessary or of running the BX parallel with the joist to the nearest baseboard must be used.

Armature and Commutator Troubles

A Discussion of Commutator Troubles Due to Open or Short-Cir cuited Coils, Poor Connections, Grounds, High or Low Bars, Dirt and Other Defects—Tests for Locating the Source of Trouble

By E. H. MARTINDALE

Chairman, Industrial and Domestic Power Committee, A. I. E. E.

This is the seventh of a series of 14 articles on the solution of commutator and brush troubles. The series began in the issue of March 24 and appears at intervals of two weeks. The earlier articles of the series were devoted to brush characteristics and a general discussion of commutation troubles, the value of careful brush selection and of commutator slotting being especially pointed out. In the present and future articles other troubles due to a variety of defects and their remedies are discussed.

THERE are a multitude of commutator troubles which have their causes in other parts of the equipment, and this article will consider only the troubles which arise from armature and commutator defects.

Open Circuits and Short Circuits and How to Find Them.

An open circuit in an armature coil produces vicious sparking when the commutator bars connecting the ends of the coil pass under a brush. In a machine operating at over 900 revolutions per minute the sparking will appear continuous. The mica will nearly always be found badly pitted between the bars connecting the ends of the defective coils. The trouble can be temporarily repaired by soldering the end connections or commutator risers together. In a lap-wound machine the defective coil can be readily located by the pitted mica between the commutator bars. In a wave-wound machine, however, the pitting occurs at two points and if the open connection is bridged over great care should be taken to avoid short-circuiting a good coil.

A poor connection between the end of a coil and the commutator riser will produce the same sparking at the brushes and pitting of the mica but in a less degree, depending on how defective the contact is. When located, the defective connection should be carefully cleaned and resoldered.

A short circuit in a coil, a short circuit between two coils, or a ground between a coil and the armature core will result in excessive heating of that portion of the armature. A ground between a commutator bar and the clamping rings will result in excessive heating of that part of the commutator as well as the portion of the armature which is connected to the commutator bars that are grounded. Usually these troubles will be accompanied by poor commutation.

The diagrams herewith illustrate the means of locating open circuits, high-resistance end connections, short circuits and grounds.

Fig. 1 illustrates a lap-wound armature. Current from a battery should be passed through the armature by brushes *BB* and a bar-to-bar test made with a telephone receiver, as shown at *a*. If the armature is in good condition, the click in the receiver will be the same between each pair of bars. If the click between any pair is less than normal there is a short circuit between two or more turns of the coil or between the commutator bars or risers. Examine carefully the commutator-bar risers to see that they do not touch each other or that no conducting material has gathered between them, and if they are found clear the end connections of the defective coil should be unsoldered and a test made between the commutator bars, as shown at *c*, with the battery in series with the telephone receiver. If a click is heard the short circuit is in the commutator, while if none is heard it is in the coil.

On the bar-to-bar test if the click between any pair of bars is greater than normal there is an open circuit or a high-resistance connection.

To determine whether the trouble is in the coil or in the end connections, the latter should be unsoldered on the defective coil and on a good coil for comparison. The telephone test should be made as shown at *d* in Fig. 1. If the click is the same in the opened coils the trouble was in the end

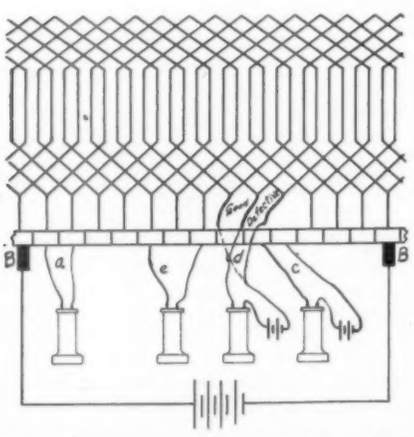


Fig. 1.—Testing for Coil Troubles on a Lap-Wound Armature.

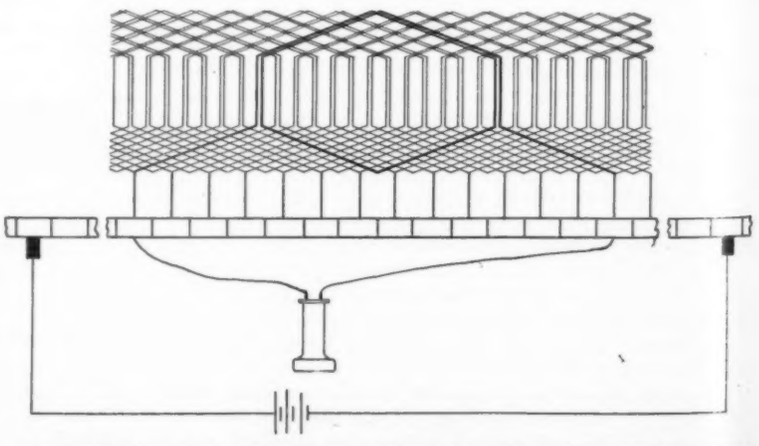


Fig. 2.—Testing for Coil Trouble on a Wave-Wound Armature with Two Turns per Coil.

connection. If no click at all is heard in the defective coil, or if the click is weaker in the defective coil than in the good coil, the trouble is in the coil and it must be replaced.

The number of coils per slot is equal to the number of commutator bars divided by the number of armature slots. If all individual coils are found correct and if there are more than one coil per slot, the first test should be repeated spanning an extra commutator bar as shown at *e* in Fig. 1. This will locate any short circuits between two coils in the same slot as the click will be less when bridging the short circuit.

Fig. 2 shows a wave-wound armature. Current should be passed through the armature as in the previous tests. Blue prints should be obtained from the manufacturer or the windings traced to determine the number of bars between adjacent brush studs of the same polarity and to determine whether the winding is progressive or retrogressive. In the usual "simplex" wave windings the number of bars will be found to be one more or less than an even multiple of the number of poles. If the number is one more the winding is progressive, and if one less it is retrogressive. In a progressive winding if we trace the connection once around the armature we arrive at the commutator bar ahead of the one from which we started. In a retrogressive winding we arrive at the bar behind the one from which we started.

There are also some wave-wound machines where tracing once around the armature will bring us to two bars ahead or behind the starting point. This is called a duplex winding.

Fig. 2 shows the method of locating short circuits, open circuits and high-resistance connections in a wave-wound armature.

Current should be passed through the armature from a small battery at one positive and one negative brush on the opposite side of the commutator from where the tests are being conducted, all other brushes being removed.

The terminals of the telephone receiver should touch the bars connected to the opposite ends of the coil as shown in Fig. 2. After the proper spacing has been determined a string may be tied between the two terminals to keep the spacing correct. The test should be conducted clear around the armature. As in Fig. 1 a loud click will denote a high-resistance connection or an open circuit. If there is an open circuit, it is probable that no click will be heard until the telephone receiver bridges the defective coil. As in *d*, Fig. 1, the coil should be opened to determine whether the trouble is in the coil or in the end connections.

If the click is less at any point there is a short circuit in the coil.

The test for short circuit between two coils in a wave winding will depend on the nature of the winding. If it is a "simplex progressive" the spacing between terminals should be one less than in the above test. If it is a simplex retrogressive the spacing should be one more. If it is a "duplex progressive" the spacing should be two less bars, and if "duplex retrogressive" it should be two more bars. A click less than normal will locate the short.

To test for short circuits between commutator bars, the bar-to-bar test should be used as in Fig. 1.

Grounded Coils or Bars.

To test for a ground all brushes should be removed, the telephone receiver should be connected from the armature shaft to the communicator bars with the battery in series.

Usually a grounded armature will cause excessive heating of both the commutator and the armature coils connected to the defective bar. After the ground has been approximately located the nearby end connections should be unsoldered and the test repeated to determine whether the ground is in the commutator or in a coil and if the latter in which coil. If the armature is wave-wound and the commutator bars are free from grounds, care should be taken to unsolder the connection at both ends of the coils before trying to locate the exact coil.

Unbalanced Armature.

A mechanically unbalanced armature may cause vibration which will result in sparking. The vibration may cause the brushes to jump from the commutator slightly. When the trouble is serious the sparking will be severe, the commutator will be burned and blackened and the brushes may be chipped or broken. The armature should be removed, placed on parallel bars or balancing ways and lead or other weight added to the armature core at the lightest side until it is properly balanced.

The same trouble may be caused by a bent armature shaft. This will not only cause vibration but may also cause armature short-circuit currents due to the resultant unequal air gaps.

High, Low or Other Nonuniform Bars.

A high bar may not appear high when the machine is stationary, but may be thrown out beyond the surface of the other bars due to centrifugal action when the machine is running at high speed. This will usually be accompanied by a clicking sound of the bar hitting the brushes. The high bar will be brighter than the average, while the bars on each side will usually be blackened. The commutator bolts should be tightened while the commutator is hot and it should then be stoned, ground or turned.

A low bar is quickly located by the formation of a flat spot. As in the case of the high bar, the commutator bolts should be tightened and the commutator turned, ground or stoned. Stoning is easier and cheaper and will be satisfactory if the flat spot is less than one half the length of the stone.

Either a high or low bar will cause severe sparking and should not be neglected, as the longer the work is postponed the more of the commutator will have to be ground or turned off.

Commutator bars in a machine sent out from the factory are usually of uniform hardness. In repaired commutators, however, bars of a different hardness may be used with the result that the commutator will not wear evenly. The best remedy is to undercut the mica and use non-abrasive brushes which will not wear either the soft or hard bars. The above remarks will also apply to commutators with mica of varying hardness.

Very rarely chattering is encountered from the use of thin brushes on undercut commutators with wide slots. The best remedy is to fill the slots with commutator cement.

Dirty Commutator.

Sparking and heating may occur from too much dirt on the commutator. The dirt may collect from the use of too much lubricant on the commutator or in the brushes, or from oil creeping onto the commutator from the bearings or from operation in a dirty location. The commutator, brushes and brush-holders should be cleaned with gasoline often enough to keep them free from gumming. These remarks apply to material collecting on the commutator and not to blackening or burning from sparking, which is dealt with in other articles of this series.

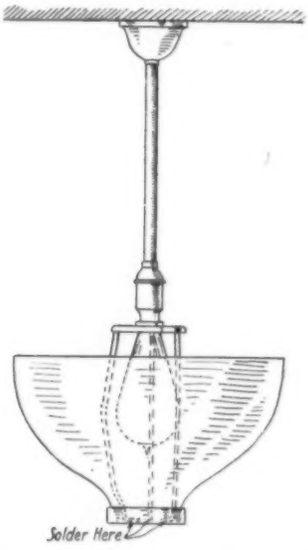
Sparks which appear to travel around the commutator, usually called "pin fire," are very seldom in any way injurious and are often very difficult to eliminate. The pin fire is caused by particles of dirt bridging over the mica and made incandescent by the current carried. The pin fire usually starts about four or five bars ahead of the brushes where the voltage between bars is high enough to get the particles red hot and lasts until these very small shorts are burned out. This usually confines the pin fire to a space from one to three or four inches wide between each pair of brush studs. If the mica is not to be undercut the best remedy for pin fire is to use a commutator stone a little each day until all holes or recesses in the mica have been removed, after which the dirt cannot collect in sufficient quantities to cause pin fire.

A poorly polished commutator may not be classed as a trouble, but a high chocolate polish is so desirable that it seems worth while to discuss the point briefly. A poor polish where sparking is not present is generally caused by either dirt collecting in fine scratches in the bars or due to acid or other oxidizing fumes. A microscopic examination will show to which the trouble is due. It may be stated that any grade of sandpaper will leave diagonal scratches due to the particles of sand tearing loose from the sandpaper and working out diagonally. Non-abrasive brushes will not remove these scratches for several months. It is therefore strongly recommended that a good commutator stone be always used for finishing or keeping in condition commutators on which non-abrasive brushes are used. If the poor polish is due to acid fumes the best remedy is to use a brush with sufficient abrasive or scouring action to keep the oxide removed.

Home-Made Semi-Indirect Lighting Fixture.

By Arthur S. Nickerson.

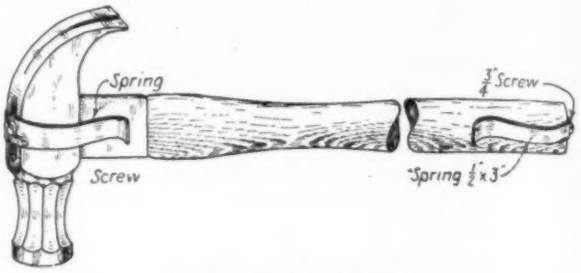
Recently when urgently needing a semi-indirect fixture to furnish a good reading light I set about making one from parts at hand. I used an opal shade from an old oil lamp. The fixture was quickly made up as shown in the sketch, the shade being inverted under a 60-watt lamp hung about 14 inches from the ceiling. For the dish on which the shade rests I used a cover from a can such as tape is shipped in.



Inexpensive Emergency Lighting Fixture.

This was cleaned and afterward gilded on the outside and painted white inside to make it a good reflector. For supporting rods or wires some small-size brass rods were used that were hooked at the top into the screw holes on an ordinary shade holder, from which the three side screws were removed. At the bottom the rods were soldered to the inside of the dish. The fixture was very quickly made and, while not ornamental, was fairly neat. It certainly was inexpensive.

Spring Holder for Hammer.—While working on a ladder and reaching for some difficult place, I have occasionally dropped my hammer and nearly upset myself from the ladder in trying to catch it. After doing this several times and being compelled to go down even to the cellar for the hammer, I hit upon the idea of putting a spring clip on the hammer by means of which it could be hung from the belt. I made the clip from a small spring about ½ inch wide by 3 inches long, drilled one end and screwed it to the hammer. It can be fastened at either end, as shown, but I find it to be in the way when put on the handle end. Therefore I prefer to have it on top. The best thing to use for the spring is a stout key-ring holder, such as can be obtained



Spring Clip for Hammer.

usually in S shape. Just slip it over the belt when finished, or if no belt is worn it can be put over the edge of the trousers or overalls. It will save lots of steps and may save a fellow-workman a bad blow from a falling hammer.

V. F. Vrooman.

Cutting Leads from Commutators.—In cutting the leads off commutators that have already been turned I find a screw driver a good tool for the purpose. It will not cut into or mar the commutator in any way, whereas a sharp chisel, which is generally used, would do so.

Joseph Mayer.

Convention of Pennsylvania Electrical Contractors' Association.—The Electrical Contractors' Association of Pennsylvania will hold its annual convention at Philadelphia on June 19 to 21, being the first meeting of the organization to be held in that city. Headquarters will be at the Hotel Adelphia, and it is expected that a large and representative delegation will be present from all sections of the state. Several interesting papers will be presented on timely subjects, as well as addresses by men of importance in the industry. It is said that representatives of the trade in different parts of the country will also attend the meetings. An extensive and complete exhibit of electrical appliances will be held in the English Room in the basement of the hotel. M. Edwin Arnold, head of M. E. Arnold & Company, Philadelphia, is president of the state association; Albert Gentel is vice-president, and M. G. Sellers is secretary and treasurer.

Among the Contractors.

Louisville electrical contractors have been finding business exceedingly good and in many of the local shops night and day work is the rule. There is a large amount of work being done in the way of installing motors in manufacturing plants which are turning to the electric drive for reasons of economy.

Harding & Simmons, of Maysville, Ky., have been awarded the contract to build the electric power plant for Cochran Brothers. The General Electric Company will install the equipment.

Frazer & Morrell, Lexington, Ky., have been awarded the contracts for installing lighting systems in Gratz and Duncan Parks, at Lexington. The contracts run to about $1,000.

J. P. Burke, Ripley, W. Va., has been awarded a contract for the installation of an electric lighting system in the local county court house.

The Kingsbury-Samuels Company, Baltimore, Md., has received a contract for electric work in the Waverly Presbyterian Church.

New Electrical Appliances

A Review of the Latest Developments and Information Respecting Electrical and Kindred Mechanical Appliances

New Appleton Box Connectors.

In the last issue there were briefly described several new conduit fittings just placed on the market by the Appleton Electric Company, 218-230 West Jefferson Street, Chicago, Ill. Another new fitting has now been added, which is illustrated herewith.

Fig. 1 shows the new Appleton box connector, which is designed especially to secure simplicity of construction, since

Figs. 1 and 2.—New Box Connector Type No. 8160 and Method of Using It with Octagon Loom Box.

it is made of steel and has but two pieces. This type of connector is of the lever type and is so arranged that when placed in the knockout of the box and after the conductor has been inserted, the two screws need merely to be tightened to make a very firm grip on the conductor. There is also a small dent in the connector, which serves to hold the conductors securely in place, so that they cannot be pulled out. The method of use is clearly shown in Fig. 2.

A New Holophane Window Reflector.

A glare-reducing reflector for exposed windows such as island, open or mirrored-backed and narrow-entrance windows, etc., and of increased efficiency is the latest addition to the Holophane line of prismatic glass reflectors.

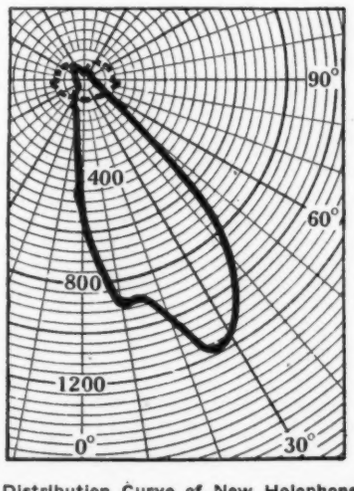
This reflector is known as No. 922 and consists of a special asymmetric prismatic reflector with an annular prismatic plate over the front half of the opening. The plate is held on by a U-shaped steel band that engages a flange on half the circumference of the reflector and the entire edge of the plate. The edge of the reflector is recessed, so that the plate has a positive position. This renders the assembling easy; the ring is fitted to the plate, placed in position and sprung over the flange of the reflector. As the illustration shows, sufficient room has been provided for inserting the lamp without removing the plate.

Front and Side Views of the New Holophone Special Window Reflector.

The addition of a refracting plate is an innovation in window-lighting reflectors and the advantages claimed for it are that it shields the eye from the bright lamp filament and at the same time increases the efficiency by reflecting the light down into the window that would otherwise escape at high angles and cause glare.

These are designed to go on standard 2.25-inch form H holders with the 100-watt type C or C2 Mazda lamp. The maximum intensity of light is delivered at about 27 degrees from the vertical and, as an examination of the distribution curve shows, practically all of the light is delivered in useful directions for lighting the goods with a small amount in an upward direction for brightening up the top of the window and lighting valances and transparencies. The distribution curve shown was obtained with a 100-watt clear Mazda type C lamp. The dotted curve shows the distribution of the bare lamp without reflector.

This reflector, which is 10 inches in diameter and 6.875 inches high, is manufactured by the Holophane Glass Company, 340 Madison Avenue, New York City.



Distribution Curve of New Holophone Reflector.

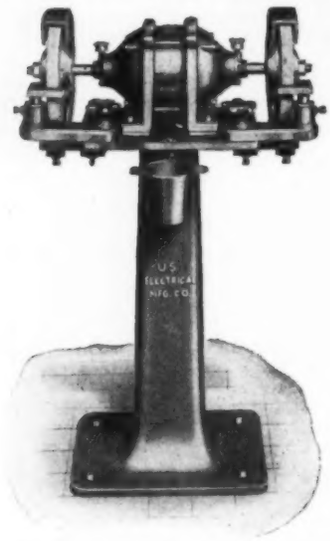
Self-Contained Grinding and Buffing Sets.

To meet the demand for a high-grade, but low-priced, electric grinding motor, the United States Electrical Manufacturing Company, 459 East Third Street, Los Angeles, Cal., has placed on the market the outfits illustrated on page 1024. They are designed especially for miscellaneous use in machine and tire-vulcanizing shops. The driving motor is either single phase, two phase or three phase and operates at either 1800 or 3600 revolutions per minute. These motors range in size from one-half to two horsepower and are said to be ex-

tremely efficient in operation. This is due not only to excellent design of the motor itself, but on account of the use of ball bearings, which are provided in special housing with sealing rings, making them proof against dirt and grit. The motor is entirely inclosed. The spindles are of heavy one-piece steel. Convenient tool rests are provided that are adjustable in any direction. The wheels are perfectly balanced. The water pot can be swung under the table out of the way if desired. The heavy wheel guards provided can be easily removed if necessary.

The outfits are provided either with motor alone for mounting on the bench, or with pedestal, as shown in one illustration, or with pedestal and complete equipment, as

Electric Grinding and Buffing Set.



Electric Grinding Set Complete with Guards, Tool Rests, Etc.

shown in the second view. If desired, a bracket is mounted on the back of the pedestal for holding a small air compressor with the necessary pulley, clutch and belt, which makes a complete outfit for use of the tire vulcanizer. The low price of these outfits is made possible because of production in very large quantities.

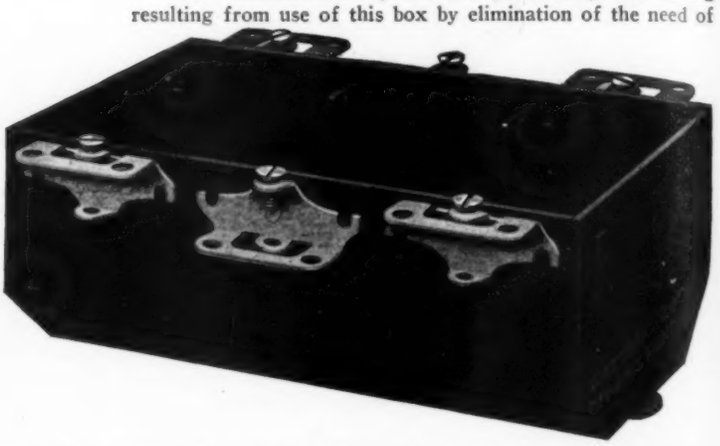
A Screwless Sectional Switch Box.

Facility in the installation of switch boxes with adaptability to various requirements without the necessity of having a great variety of parts on hand has long been sought by the electrical contractor. This ideal has been achieved in a new type of switch box, which is being marketed under the appropriate name "Perfection" sectional screwless box, by the A. B. Wilson Company, Leader-News Building, Cleveland, O.

This box possesses unique features that have been incorporated in it after a great deal of preliminary study, experimental work and actual trial installations before it was placed on the open market. The box is made of high-grade steel and is made in carefully prepared dies to insure accuracy in registry. The body is in one piece with inside knockouts. The end walls are separable and when slipped into place are automatically locked and securely held at top and bottom without use of a single screw. This makes it very easy to arrange the boxes in gangs of any desired number, since on removal of the end walls the bodies act merely as spacers and fit side by side perfectly. The boxes are obtainable complete with end walls and also with the spacer bodies alone. The method of assembling or ganging is clearly shown in the accompanying illustration.

Another feature is that the boxes have reversible ears, which are turned up for use on old work and turned down for new work. This reversal is quickly made. The boxes take any standard wall switch or receptacle and have ample inside room for this purpose.

The manufacturers point out particularly the saving resulting from use of this box by elimination of the need of



"Perfection" Three-Gang Switch Box, Made of One Box and Two Spacers. Middle Ears Are Turned Down and End Ears Up.

a multiplicity of sizes and types, since this box serves for all purposes. Moreover, assembling of the outfit on the job to meet all requirements is greatly simplified.

Master Electrically Driven Coffee Cutter.

By means of the cutters shown herewith steel-cut coffee can be furnished by the grocer in bulk with convenience, and at a profit. These cutters are part of a line of "Master" coffee cutters manufactured by the Master Cutter Machine Company, Cincinnati, O. They are built along entirely different lines from any of the coffee mills on the market, and have been evolved to meet the demand for machines that would cut, not grind, coffee.

Master coffee cutters cut the coffee uniformly and evenly. Granulating and pulverizing are done on the same burrs, giving a sand-like grain especially adapted to all kinds of percolators or drip-pots now in such wide use. There are two sets of burrs, one of which revolves. The other set is stationary. The burrs are especially designed with diamond-shaped teeth. They are self-sharpening and self-alining, having special ball bearings which take out all play. Thus the burrs cannot "wobble" and produce uneven granulation.

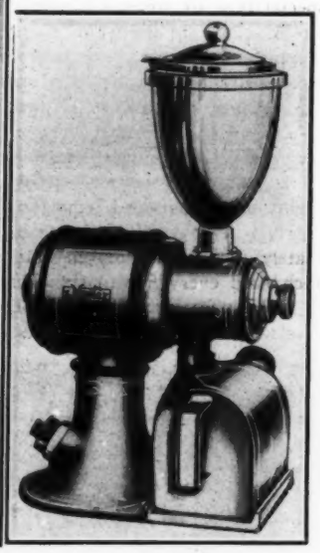
These machines are operated by totally inclosed, low-

speed Westinghouse motors designed for heavy duty and without complicated mechanism to need adjustment. Due to the fact that a low-speed motor is employed no gears are necessary. The motors are equipped with radial and thrust ball bearings, which reduce friction to a minimum and prevent wobbling of parts. They are silent and true-running. The only parts needing lubrication are the ball bearings, and these need only be oiled about once a year. Thus there is no oil to accumulate in the burr case, none to get into the coffee, and all the nuisance of oiling is removed.

The Master line of cutters consists of single and double-end styles and a "three-in-one" machine, which, besides granulating and pulverizing the coffee, can be used for chopping meat.

The single-end machines are made in two sizes and are of sufficient capacity for most stores. Provision is also made for attaching the other end whenever desired. They are

Master Special Display Type of Coffee Cutter.



Master Single-End Electric Coffee Cutter.

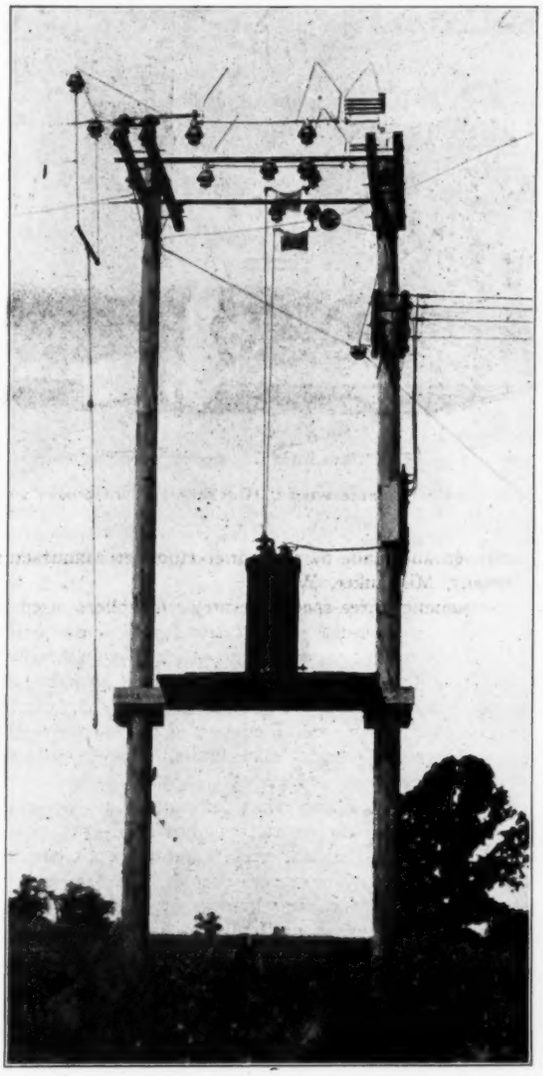
capable of producing the finest grade of coffee practical for drip-pots and as coarse as wanted for any pot, without injury to the burrs. The double-end machines are large enough to meet all requirements of the busiest stores. Both ends granulate and pulverize, and may be used simultaneously. The hoppers each hold seven pounds. Both the single and double-end machines are furnished with counter bases or floor pedestals.

With a chaff-removing cutter and refiner the chaff is removed from the coffee as it is cracked preliminary to final grading, by means of a vacuum attachment, and blown into a case underneath the machine. Besides the chaff, the adhering dust is removed, leaving no less of coffee value but more of aroma and desirability. About one-half ounce is removed to the pound; less would leave too much chaff, more would be wasteful. What is removed has no value. After the chaff is removed the coffee is graded and cut into even granules or pulverized. The product obtained is said to rank in appearance above any sifted and graded coffee put up in cans, with the advantage of being perfectly fresh and having a consequent increased value for the pot. This cutter and refiner may be used on the counter, or in conjunction with the patent display case shown, which serves to show customers the grades of coffee obtainable and just how the machine operates.

Serving Small Towns Inexpensively.

The small-capacity single-phase outdoor substation now occupies a very definite place in high-tension distribution. For many towns single-phase service is sufficient to meet the demand of lighting and small-power loads, and this form of substation can be installed at a low cost.

The installation shown in the accompanying illustration is of the "Unit type," manufactured by the Delta-Star Electric



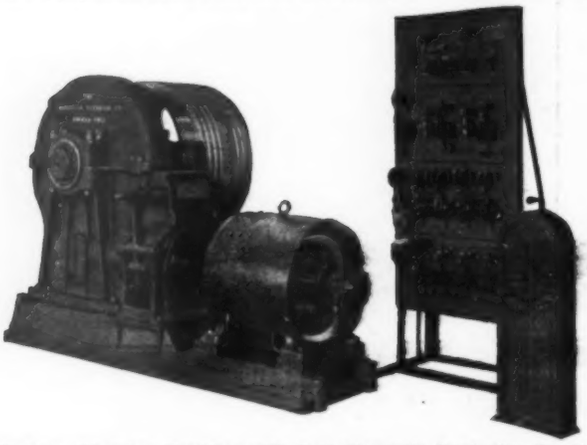
Single-Phase Outdoor Substation Suitable for Small Towns.

Company, Chicago, Ill. These single-phase stations can be furnished for any size capacity, and as the load increases can be converted to three-phase types.

Sangamo Electric Company, Springfield, Ill., announces the opening of a San Francisco office at 37 Stevenson Street, in charge of L. A. Nott, district manager. This office will represent the Sangamo Company in Northern California and that part of Southern California not handled by the Sangamo Company's Los Angeles office. Mr. Nott is well known to the electrical fraternity on the Pacific Coast, having been for many years with the Standard Underground Cable Company, and latterly with the K. P. F. Electrical Company, which association he will continue. The Sangamo Company, which manufactures the well known watt-hour meters, ampere meters, etc., of that name, will now carry a complete stock of meters, repair parts, etc., in San Francisco.

Elevator Control Equipment in New Willys-Overland Service Station, New York.

The controller, elevator machine and motor for one of the two electric elevators recently installed in the new Willys-Overland Service Station, Tenth Avenue and 57th Street, New York City, are shown in the accompanying illustration. The elevators are of the moderately high speed (400 feet per minute) passenger type, while the machine is of the single-gear V-groove traction construction. The elevator machines and equipment were built and erected by the Haughton Elevator & Machine Company, Toledo, Ohio, and the controllers were designed and made by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.



Electric Elevator Machine with C-H Magnetic Controller Panel.

The magnetic three-speed elevator controllers used in this installation govern the reversal and speed control of the motors. They permit no more current to the motor than is necessary to hoist the maximum load, thus protecting the motor against injury due to excessive currents. The car in its travel is always under the full control of the operator. When it approaches the top and bottom limits, however, it is automatically slowed down and smoothly brought to rest.

Safety is the primary consideration. The design and arrangement of wiring connections are such that no combination of grounds or short circuits can cause the car to run into the overhead beams or into the pit. The slacking of a hoist cable, from any cause whatever, immediately stops the car from further motion until the trouble is corrected. An overspeed governor with safety guide grip is employed so that should the car run over its rated speed of 400 feet per minute, the current supply to the motor will be interrupted and the guide grips will act to immediately stop the car. Two magnetically operated brakes are mounted on the machine, one for braking the drum shaft and the other braking the motor shaft.

Installed in the same building are three heavy-duty freight lifts for handling automobiles. These elevators have a capacity of 5000 pounds at 135 feet per minute. They are also equipped with C-H magnetic controllers for operation by car switches in the cars.

An Electric City and Street Guide.

A novel and practical device, the "Electric Directory," has been installed by many prominent New York City hotels, and will soon be in other cities in the United States.

The apparatus serves the dual purpose of an accurate street and general city guide and attractive sign board. It is of pleasing appearance, about 16 square feet in size, and has an all-glass-and-mirror front. In its center is a large map of New York City (or other city where installed) with a number of interchangeable advertising spaces arranged alongside of it. Below the map are two boards, each mounted with 30 numbered push buttons. In a pocket between the push-button boards is an index book wherein every point shown on the map is alphabetically listed, with a number placed opposite each of them. All a person has to do to operate the guide is to press the button bearing the number of the place sought, say, railroad station, part of street or avenue, etc., whereupon a bright light appears on the map giving the desired location, while a red light indicates the hotel or other place where the directory is installed as the starting point. The pressure of any button automatically flashes up all the advertisements, which together with the map are, however, visible and readable even when not illuminated.

The "Electric Directory" is manufactured by the Electric Directory Company, Incorporated, 104 Fifth Avenue, New York City, its president, M. Weller, being the originator of the clever device, which is successfully used in various European countries.

The apparatus is entirely constructed of steel. The map is divided into 60 small sections, a lamp being placed underneath each. Fifty four-volt lamps are evenly distributed behind the advertising spaces. The current is supplied by a special type of storage battery. The pressure of any button closes the circuit to one map light and to the starting-point indicator, automatically operating a relay which closes the second circuit for the 50 advertising lights.

Advertisers and hotel proprietors have acknowledged the value of the Electric Directory, both as an information device and as an advertising medium. The number of persons using the Directory daily can only be estimated, although an idea can be obtained from the fact that for one of the larger hotels the powerful storage batteries, which permit approximately 1000 flashes of one-half minute duration, have to be recharged every five to six days.

The photograph from which this illustration was made was taken in the Hotel Martha Washington, New York City.

Electric Directory of Greater New York in Use in a Prominent Hotel.

Activities in the Trade

Standard **Electric Stove Company** has distributed a patriotic calendar for the month of June. This is one of a series of art calendars that the company is issuing each month. This company has also sent out a new folder describing its 40-watt electric cooker.

Vulcan **Fuel Economy Company,** Chicago, Ill., in the May issue of "Vulcan's Forge" publishes a very interesting article entitled, "Development of Standardizing a Product" in which the conditions which characterized the soot-cleaner business are outlined. In the same issue is a list of recent orders for Vulcan soot cleaners from Henry L. Doherty & Company, this company having adopted the Vulcan as standard.

Crouse-Hinds **Company,** Syracuse, N. Y., has issued a large folder dealing with "daylight protection at night." This shows the various types of Imperial projectors made by this company as they can be used to great advantage for protective lighting of industrial plants, especially at a time like the present national emergency. The company's new bulletin, No. 302, describes the Imperial flood-light projectors and Imperial reflectors, made by the company for this purpose as well as for the illumination of roundhouses and industrial plants in general, steamboat projector lighting, motorboat lighting, etc.

Stow **Manufacturing Company,** Binghamton, N. Y., is sending out copies of a large folder, showing its portable and semi-portable electrically driven grinders for use in various manufacturing plants, particularly those engaged in the manufacture of munitions of war. The company shows that where efficiency and speed in production are necessary, as is true in these particular industries, the use of these tools proves to be very advantageous. Most of these tools make use of the Stow flexible shaft and the Stow variable-speed motor.

The Boiler-Kote Company, Chicago, Ill., has just issued a 16-page bulletin on "Steam Boilers and How to Rid Them of Scale, Pitting and Corrosion." This little treatise gives a clear and brief exposition of this subject—one that has become increasingly important to steam users with each new advance in wages, coal prices, and the cost of boiler replacement. C. A. Newman, formerly manager of sales promotion for Henion & Hubbell, Chicago wholesalers in power pumps, mining and mill supplies, has been made sales manager of The Boiler-Kote Company with general sales offices in the Fisher Building, Chicago.

Electric Machinery Company, Minneapolis, Minn., has just issued Bulletin No. 168, dealing with synchronous motors. Power-plant owners and engineers are very anxious to secure the very latest data on synchronous motors. This bulletin gives a clear idea of the subject, and demonstrates the fact that the synchronous motor has left the experimental stage and is now a commercial success in a great variety of applications formerly considered impossible. It contains a complete analysis of the characteristics, the uses and the advantages of synchronous motors as compared with induction motors. Charts showing performance curves, also full description of starting torque, pull-in torque, etc., are given. It is a practical book for the power superintendent, not a theoretical text book. The Electric Machinery Company will be pleased to send copy of this bulletin to engineers and power-plant operators or other interested parties.

Lincoln Electric Company, Cleveland, O., announces that the Ross Power Equipment Company has been appointed its representative at Indianapolis, Ind., with headquarters at 617 Merchants' Bank Building.

The R. Thomas & Sons Company, East Liverpool, O., has issued a folder on the Thomas line-wire protector. This is made in sizes suitable for voltages up to and including 66,000, eliminating danger caused by accidental burning off of the line wire.

Central Electric Company Employees Show Patriotism.—The employees of the Central Electric Company, of Chicago, have taken an active part in promoting, locally, such movements as that for preparedness, the campaign for Red Cross subscriptions, the National Security League, the Navy League, etc. Just now they are interested in the Liberty loan for which they have taken subscriptions among themselves totaling more than $12,000 and representing more than 80 individuals. The Central Electric Company as a corporation has subscribed for $100,000 in addition to this.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued Catalog 38, on Westinghouse small motors and generators. This contains general information of value in selecting and applying small motors. Three types of single-phase, two types of polyphase and one type of direct-current motors are described with much detail. Among applications of these motors described are electrically driven fans and blowers, sewing-machine motors, motor-generators, buffing motors, generators for small electric lighting plants, etc. A very complete array of illustrations, curves, etc., is included. The company has also issued booklet F4359, describing Westinghouse instrument transformers; various types of current and voltage transformers as used for voltages ranging up to over 100,000, are described in detail.

Driver-Harris Wire Company, Harrison, N. J., has filed notice that its name has been changed to Driver-Harris Company. The former name did not comprehensively designate the products of the concern and while wire makes up an important part of the production, it manufactures largely alloys and pure metals in the form of strip, rods, sheets and castings. This company also manufactures flexible heater cords and wire rope. The company also announces the publication of a new bulletin form of catalog covering its complete line of products, with the exception of resistance materials, which are covered in the regular resistance catalog. These new bulletins include Monel Metal, Pure Nickel, Wire Rope, Heater Cord, Cold Rolled Steel Strip, Brass, Bronze and Phosphor Bronze Wire and "Nichrome" Castings, and can be obtained upon request.

SKF Ball Bearing Company, of California, in order to more readily supply the rapidly increasing demand for its bearings on the Pacific Coast, has been organized for the sale of these well known self-alining radial and thrust ball bearings. The main office of this company under the direction of A. M. MacLaren has been opened in San Francisco at No. 341 Larkin Street, and at this office a large and assorted stock of bearings will be carried. The engineering services of the company will also be available by addressing this office. The company's engineers will be glad to investigate conditions and assist the users of ball bearings, present and prospective, in determining the best means of reducing friction losses and selecting an equipment. From

sketches showing the arrangement, with data giving the loads and speeds and other conditions which bear on the problem, the engineers' suggestions based on their wide experience will be found helpful. They will gladly answer questions, make suggestions upon the data submitted, examine and criticise the drawings, or make drawings showing the preferred method of applying S K F ball bearings to meet particular conditions. Proper sizes and arrangements will be suggested.

Sprague Electric Works of General Electric Company, 527 West 34th Street, New York City, has issued bulletin No. 48700A, dealing with Sprague Electric monorail hoists. These are of the cage-controlled type and are used in all kinds of industrial plants or facilitating the handling of materials at a minimum expense. These hoists are made in several types and the method of mounting the monorail can be adapted to suit the conditions. The bulletin is very well illustrated with views not only of the different types of equipment, but of typical installations in a great variety of plants. The company has also issued a new leaflet on ventilating fans of the motor-driven type. This points out the uses of equipments of this kind for ventilating motion-picture theaters, restaurants, industrial plants, etc., and gives data of equipments suitable for this purpose.

Gray and Benjamin is the name of a new firm of counselors to technical advertisers, which has been established in Chicago at 301-2 Transportation Building. This firm will act as advertising counsel to manufacturers of electrical, mechanical, chemical and kindred products. They will analyze and report upon problems of manufacture and distribution and will supervise the preparation of advertising copy for technical and trade papers, booklets, house-organs, catalogs and incidental advertising propaganda. Their special function will be to eliminate waste in advertising effort and expenditure, bringing the product and the market together under conditions of maximum efficiency. Few men have been more prominent in publishing and advertising circle during the past twenty years than A. A. Gray and Charles L. Benjamin. Their alliance as counselors to technical and trade advertisers brings together a rare combination of literary ability, intimate knowledge of manufacturing and merchandising conditions, far reaching sources of technical information and wide experience in the preparation and printing of technical publicity. Mr. Gray is widely known as managing editor of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN. A brief sketch of his career appears on page 1,000 of this issue. Mr. Benjamin has been engaged in advertising work since boyhood, entering the employ of the old George P. Rowell agency in 1888 and becoming the first editor of *Printers Ink*. He was later employed by The Century Company (New York) to advertise the magazine and book publications of that company. He served in the Spanish-American war with Troop C, of Brooklyn, and on his return to the United States began to specialize in technical advertising. In 1906 he became advertising manager of the Cutler-Hammer Manufacturing Company (Milwaukee) where for nine years his work in technical and trade publications attracted wide attention. For the past two years he has engaged in advertising work on his own account, acting as advertising counsel to a number of manufacturers of nationally known products.

A. A. Gray and Charles L. Benjamin.

Calumet & Hecla Mining Company to Equip with Storage-Battery Locomotives.—After many months of careful investigation as to the best methods of hauling rock underground, the Calumet & Hecla Mining Company's engineers have decided to adopt storage-battery locomotives and have recently placed an order for 31 Goodman locomotives each equipped with 48 cells MV-13 Ironclad-Exide battery manufactured by the Electric Storage Battery Company of Philadelphia, Pa. These locomotives will be assigned to the various levels and will each haul daily between three to four hundred tons of rock to the shafts. The charging circuits will be installed throughout the mines, the locomotives being retained in their working location ready at all times for service. The most up-to-date methods and apparatus for charging will be used, batteries being charged according to the constant-potential method. The present project calls for the ultimate use of a large number of electric locomotives, which will be the largest fleet known in this class of work.

General Electric Company, Schenectady, N. Y., announces that its New York offices will be moved June 16 from 30 Church Street to the Equitable Building, 120 Broadway. The entire twentieth floor of the building has been especially arranged and furnished for the General Electric Company. For nine years these offices have been at 30 Church Street where the company located its New York offices when it outgrew the "Edison Building," at 44 Broad Street. This building was originally built for the Edison General Electric Company which, in 1892, was combined with the Thomson-Houston Electric Company to form the General Electric Company. In the quarter century since the General Electric Company was formed, its business has increased from about ten millions in gross sales the first year of its organization to gross orders of $167,169,000 during the twenty-fifth year and its sales offices have naturally increased in number and in importance. The company's offices in New York are the largest and most important among its district offices.

American Gear Manufacturers' Association Convention.—The recently organized American Gear Manufacturers' Association held its first convention at the Hotel Schenley, Pittsburgh, Pa., on May 14 and 15. An interesting program was arranged and elaborate preparations made by the Pittsburgh members for entertaining the visiting manufacturers. The Association has been organized for the purpose of developing, standardizing and improving all products of the gear industry. In view of the present national situation this convention will undoubtedly have a very important bearing on the efforts being put forth by the Government for absolute standardization in all lines of manufacture. The officers of the Association are: F. W. Sinram, Van Dorn & Dutton Company, Cleveland, president; H. E. Eberhardt, Newark Gear Cutting Machine Company, Newark, N. J., vice-president; F. D. Hamlin, Earle Gear & Machine Company, Philadelphia, secretary, and Frank Horsburgh, Horsburgh & Scott, Cleveland, treasurer. The convention was opened Monday, May 14, by F. W. Sinram, president, and the morning devoted to an executive session. In the afternoon, S. L. Nicholson, sales manager of the Westinghouse Electric & Manufacturing Company, spoke on "The Ins and Outs of an Industrial Organization," and James E. Gleason presented a paper on "The Spiral or Curved Tooth Bevel Gear." On Tuesday afternoon the delegates visited the works of the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa., where they witnessed methods of manufacturing Bakelite Micarta for gears, after which they were the guests of the Westinghouse Company at a dinner in the club rooms of the Pittsburgh Athletic Association.

Latest Approved Fittings

The electrical fittings illustrated and described in this department have been approved by the Underwriters' Laboratories, Incorporated, after examination and tests conducted under standards of the National Electrical Code as recommended by the National Fire Protection Association

ATTACHMENT PLUGS, Fuseless.—General Electric Company, Schenectady, N. Y.
"G. E." 660 watts, 250 volts, catalog No. GE451.
Cord connectors, 660 watts, 250 volts, catalog Nos. GE716-7.
Caps, catalog Nos. GE625, GE662-3.
Listed May 5, 1917.

CABINETS AND CUTOUT BOXES, Sheet Metal. — American Electric Steel Cabinet Company, 2409 North Ashland Avenue, Chicago, Ill.
Listed May 22, 1917.

CONDUIT BOXES.—Ideal Electric Company, 763 Gratiot Avenue, Detroit, Mich.
Pressed-steel conduit boxes for use with flexible tubing and conduit. "O. K."
Listed April 23, 1917.

CONDUIT BOXES.—H. T. Paiste Company, Thirty-second and Arch Streets, Philadelphia, Pa.
Cast-iron conduit boxes. Pipe taplets, types GA, GGC, GGE, GGH, GL, GX, HA, HH, HLA, LBL, LFM, SS, T, TB and TM.
Listed May 5, 1917.

FIXTURES. — John H. Latham, 1009 Hull Street, South Richmond, Va.
Label service.
Listed May 7, 1917.

GROUND CLAMPS.—Ideal Electric Company, 763 Gratiot Avenue, Detroit, Mich.
Ground clamps for use with one-inch rigid conduit or less. "O. K."
Listed April 30, 1917.

HEATING APPLIANCES, Cooking and Liquid.—General Electric Company, Schenectady, N. Y.
Disk stoves, 225 to 1000 watts. Types D-81, D-82, D-83.
Listed May 15, 1917.

HORNS.—Russell Electric Company, Danbury, Conn.
"Russell," 220 volts or less, alternating current, catalog No. 7000.
Listed April 18, 1917.

LAMP CLUSTERS.—Benjamin Electric Manufacturing Company, 120-128 South Sangamon Street, Chicago, Ill.
Multiple types 1K, 7, 18, 19.
Listed May 16, 1917.

MOTION-PICTURE MACHINES, Miniature. — Maggard-Bradley Company, Morehead, Ky.
Portable, motor-operated motion-picture and stereopticon machine of miniature type. The electrical parts of this device comprise a 250-watt or 400-volt incandescent lamp, snap switch and portable cord for attachment to supply circuit. "Cosmograph," type A, model 17S, 550 watts or less, 110 volts.
Listed April 27, 1917.

OUTLET BUSHINGS AND FITTINGS.—H. T. Paiste Company, Thirty-second and Arch Streets, Philadelphia, Pa.
Cast-iron nipple for threading on end of conduit and having one-hole porcelain bushing. For use when at exposed end of conduit (but not under fixture canopies) for bushing only one wire from conduit. "Paiste" pipe taplets, ½ to 4-inch size, type AR.
Listed May 7, 1917.

OUTLET BUSHINGS, Service Entrance.—Standard Electrical Manufacturing Company, 504 Prospect Avenue., S. E., Cleveland, O.
This cast-iron fitting consists of a conduit L, having pipe-like projection with oblong opening facing downward near end, the opening being closed by a porcelain insulating bushing with two outlet holes. The device is designed for installing on outside of building, to which it may be secured by two screws. "Diamond E," ½ and ¾-inch sizes.
Listed May 15 1917.

PRESSING IRONS. — Pelouze Manufacturing Company, 232 East Ohio Street, Chicago, Ill.
Domestic type, 250-650 watts, catalog No. A-6, 9-pound size.
Listed April 13, 1917.

RECEPTACLES (For Attachment Plugs) AND PLUGS.—General Electric Company, Schenectady, N. Y.
Adapter for use with flat outlet box where presence of moisture is not probable. Catalog No. GE664.
Listed May 15, 1917.

RECEPTACLES, Mogul Base. — Benjamin Electric Manufacturing Company, 120-128 South Sangamon Street, Chicago, Ill.
"Benjamin" porcelain-shell. Keyless, catalog Nos. 69, 169, 691, 692.
Listed May 15, 1917.

RECEPTACLES (For Attachment Plugs) AND PLUGS.—Chelten Electric Company, 314 Armat Street, Philadelphia, Pa.
"Chelten," 10 amperes, 250 volts, catalog No. 3005.
Listed March 28, 1917.

RECEPTACLES, Medium Base.—General Electric Company, Schenectady, N. Y.
"G. E." porcelain shell.
Key, catalog Nos. GE872-5.
Keyless, catalog Nos. GE877-80.
Pull, catalog Nos. GE862, GE864-9, GE871.
Listed April 27, 1917.

RECEPTACLES (For Attachment Plugs) AND PLUGS.—Bryant Electric Company, Bridgeport, Conn.
"Bryant" or "Perkins" Spartan. 10 amperes, 250 volts, catalog Nos. 29, 79, 104-10; caps ME, MG.
Listed May 1, 1917.

SIGNAL APPLIANCES, Horns and Buzzers. — Benjamin Electric Manufacturing Company, .120 - 128 South Sangamon Street, Chicago, Ill.
"Benjamin," 125 volts or less, alternating current, catalog No. 8297; direct current, catalog No. 8296.
Listed May 16, 1917.

SIGNS.—Colorado Convex Electric Sign Company, 1440 Curtis Street, Denver, Colo.
Electrically illuminated display signs for general use.
Listed April 18, 1917.

SOCKETS, Medium Base.—Harvey Hubbell, Inc., Bridgeport, Conn.
"Hubbell" porcelain shell, keyless, catalog Nos. 3410, 3445.
Listed May 5, 1917.

SOCKETS, Medium Base.—General Electric Company, Schenectady, N. Y.
"G. E." metal shell.
Push, electrolier, catalog Nos. GE 723-6.
Listed April 26, 1917.

SOCKETS, Medium Base.—General Electric Company, Schenectady, N. Y.
"G. E." porcelain shell.
Key, catalog Nos. GE815-7.
Keyless, catalog Nos. GE819-21.
Pull, catalog Nos. GE639-44.
Listed April 27, 1917.

SWITCH BOXES.—Sieffert Electric Company, 212 Sycamore Street, Evansville, Ind.
Cast-iron single and gang type boxes for mounting switches and attachment-plug receptacles. "SECO." Flexible tubing pattern, catalog Nos. 1501-4.
Listed March 10, 1917.

SWITCHES, Surface. — General Electric Company, Schenectady, N. Y.
"G. E." Single-pole, catalog Nos. GE-231, GE238.
Listed May 25, 1917.

Personal and Biographical

E. C. DEAL, of Baltimore, Md., has been appointed manager of the Trinidad (Colo.) Electric Transmission Railway & Gas Company.

LINCOLN BEERBOWER, manager of the Enid Electric & Gas Company, Enid, Okla., is one of the 25 charter members of the newly organized Rotary Club.

T. O. KENNEDY, manager of the Massillon (O.) Electric & Gas Company, has been appointed superintendent of Denver Gas & Electric Ligt Company.

W. L. MILLER, manager of the Interstate Light & Power Company, Galena, Ill., is secretary of the committee in charge of the sale of Liberty Loan bonds in Galena.

G. R. C. WILES, Charleston, West Va., has been appointed a member of the Public Service Commission by Governor Cornwell, to succeed Elliott Northcott, resigned prior to expiration of term, June 1.

D. C. GREEN, manager of the Fort Smith Light & Traction Company, Fort Smith, Ark., has been made a member of the committee which will confer with Major Wood with reference to having one of the army cantonments located at Fort Smith.

ROBERT MONTGOMERY, manager of the commercial department, Louisville Gas & Electric Company, was in charge of Louisville's delegation of advertising men who attended the St. Louis convention of the Associated Advertising Clubs.

J. W. KELSH, assistant manager and superintendent of the Eastern Wisconsin Electric Company, Fond du Lac, Wis., has resigned his position and will leave the employ of the company about July 1. Mr. Kelsh will take a vacation before announcing his plans for the future.

HERBERT W. ANDEM, Montclair, N. J., in charge of electrical work at the plant of the Cubey Sugar Company, near San Diego, Cuba, was killed on May 31, as a result of accidental contact with high-voltage lines. Mr. Andem was about forty-two years of age and had been in the employ of the company for some years past.

Governor Cornwell, West Virginia, has appointed Wells Goodykoontz, Frederick Fox and C. C. Coalter, of Charleston, Sutton and Hinton, respectively, members of a water power committee to investigate and make a report on the development of state water power and recommend legislation at the next session of the legislature.

ROBERT ABBOTT, who for the past eight years has been connected with the sales organization of the Bryant Electric Company, and has managed its New York office since it was opened in 1913, has volunteered for service in the Roosevelt Base Hospital unit, and sailed for France last week. No announcement has been made by the company with reference to his successor in the New York office.

OSCAR T. CROSBY, who was recently appointed assistant secretary of the treasury is a noted electrical engineer and has had a wide experience in the electrical industry. He was born at Ponchatoula, La., on April 21, 1861, and entered the United States Military Academy in 1878, graduating in 1882. Mr. Crosby resigned from the army as first lieutenant of engineers, 1887, to accept the position of general superintendent of the Sprague Electric Railway & Motor Company. Later he was made general manager of the railway department of the General Electric Company, and from 1887 to 1896 was an experimenter in and author on electrical subjects. Mr. Crosby then entered private business and was president of several local electric railway and lighting companies in Washington, D. C., and several public utility corporations in Wilmington, Del., Chester,

Oscar T. Crosby.

Pa., and Trenton, N. J. He explored portions of Abyssinia and Soudan in 1900, and portions of Turkestan and Tibet in 1903. He traversed Mesopotamia and made explorations in Borneo in 1913-14. He served as director in charge of work of the Commission for Relief in Belgium for six months of 1915, in the portion of Belgium and of France now occupied by Germany. He became assistant secretary of the treasury on April 17, 1917. Mr. Crosby is a member Royal Geographical Society (London); president World's Federation League. He is a member of the Metropolitan and Cosmos Clubs (Washington); University Club (New York); Army & Navy Club (Washington), Montgomery Country Club (Washington). He is the author of Tibet and Turkestan; How to Strike—Why to Strike, 1910; Draft Constitution for International Court; Electrical Railway in Theory and Practice; and various papers on geographical and scientific subjects.

B. W. ARNOLD has been appointed manager of the Eastern Wisconsin Electric Company, with headquarters at Oshkosh, Wis., and with jurisdiction over the systems at Oshkosh and Fond du Lac. For the past ten years Mr. Arnold has been with the Illinois Traction System.

F. C. PRATT, assistant electrical engineer, Henry L. Doherty & Company, has been made manager of the Alliance (O.) Gas & Power Company, succeeding W. J. Rose, resigned. Mr. Rose resigned as head of the Alliance Company to enter the steel business.

JAMES G. ALLEN has been appointed general superintendent of the Southern Wisconsin Electric Company, with headquarters at Lake Geneva, Wis. Mr. Allen has been employed by the company as local manager for some time and also served as president of the Equitable Electric Light Company for a number of years.

O. R. STURZINGER, of Genoa, O., for fifteen years the superintendent of the Northwestern Ohio Railway & Power Company, has resigned his position, to devote his time to other interests. The lighting systems between Toledo and Marblehead, O., will be in charge of Charles Matthews, who was recently appointed superintendent.

THOMAS N. MCCARTER, president, the Public Service Corporation, Newark, N. J., has been appointed a member of the newly created Hudson River Bridge and Tunnel Commission by Governor Edge, for a term of three years. The commission is to devise plans for the construction of a bridge over the Hudson River, as well as a tunnel for highway traffic.

FRED V. GANNT, president of the Louisville Iovian League and manager of the Louisville branch of the General Electric Company, is taking a prominent part in the work for placing of the Liberty Loan Bonds in Louisville. He was recently a speaker at the plant of the Louisville Car Wheel & Railway Supply Company, at a meeting of the men which was given over to consideration of the bonds.

OBITUARY.

JOHN C. BRIDGMAN, general manager of the Hazard Manufacturing Company, Wilkes-Barre, Pa., died suddenly of heart disease on May 28. Mr. Bridgman was born at Northampton, Mass., fifty-five years ago, and has been a resident of Wilkes-Barre for about thirty years. In 1888 he became sales agent for the Hazard Manufacturing Company, and later was promoted to the position of secretary. About twenty years ago he was made general manager of the company, and through his efficient service, the concern has become known as one of the most prominent in the electrical business. Mr. Bridgman is survived by a wife and two sons.

Current Electrical News

WEEKLY RECORD OF CONSTRUCTION ACTIVITIES

EASTERN STATES.

ROSEBANK, STATEN ISLAND, N. Y.—The L. A. Dreyfus Company, Maple Avenue, manufacturer of rubber goods, has filed plans for the erection of a new two-story power station for plant operation, to cost about $25,000.

BERNARDSVILLE, N. J.—An election to vote an appropriation for lighting and elect the lighting commissioners for the coming year will be held on June 20.

COLLINGSWOOD, N. J.—The Public Service Electric Company has recently completed the installation of a new street-lighting system.

GLOUCESTER CITY, N. J.—The city council has voted to make a new contract for street lighting with the Public Service Electric Company, providing for the installation of new street lights under a revised system of operation. The new contract will become effective September 1.

LIVINGSTON, N. J.—At a special election, June 5, it was voted to adopt an electric lighting system for streets in the township.

NEWARK, N. J.—Election for lighting appropriations for township streets were held June 5 at Mountain Lakes, Little Falls, German Valley, Newmarket and Reading, with favorable votes in each instance. Lighting commissioners to provide for the service were also elected.

NEWARK, N. J.—The Public Service Electric Company has awarded a contract to the Hay Foundry & Iron Works, Plum Point Lane, for the construction of an addition to its Essex power station at a cost of $168,135.

NEWARK, N. J.—Piper Brothers, Trenton, have submitted a low bid to the Board of Freeholders for the installation of new equipment at the Overbrook Hospital power plant, including coal and ash-handling equipment and other work, at a cost of $78,300. Other extensions and improvements at the station will bring the aggregate cost to $181,365.

PERTH AMBOY, N. J.—The Board of Aldermen has passed an ordinance over the mayor's veto providing for an appropriation of $50,000 for the installation of a distributing system for the municipal lighting plant for commercial service.

ROCKAWAY, N. J.—The International High Speed Steel Company will install new electric-operated equipment at its steel plant. The New Jersey Power & Light Company is now furnishing service, with load averaging about 1,400 horsepower.

WEEHAWKEN, N. J.—The Board of Education will receive bids until 8 p. m., June 20, for electric work in School No. 6. William Mayer, Jr., 711 Bergenline Avenue, West New York, is architect. Harry Kuhlke is clerk of the board.

BENTON, PA.—The Benton Hydro-electric Company has made application to the Public Service Commission to issue bonds for $75,000 for extensions, etc.

BOSWELL, PA.—The Standard Quemahoning Coal Company is planning for the installation of new electric haulage equipment and other apparatus. The Penn Electric Company, Johnstown, is negotiating with the company for the improvement.

EASTON, PA.—The Pennsylvania Utilities Company has commenced the installation of a new 3,500-kilowatt turbine unit at its Dock Street station. Four new boilers will also be installed.

HARRISBURG, PA.—The Public Service Commission has received applications from the Ortanna Electric Light & Power Company, Ortanna, for permission to issue stock for $11,000 for improvements. The Lykens Valley Light & Power Company, Williamstown, has filed notice to issue bonds for $12,000 for betterments.

JOHNSTOWN, PA.—The Citizens Light, Heat & Power Company is installing new outside lines for a police signal system for the city.

NORRISTOWN, PA.—The following electric companies are being organized and will soon make application for charters of incorporation: Washington Square Electric Light & Power Company, to furnish service in the township of Whitpain; The Railway Electric Light & Power Company, to supply service in Lower Gwynedd; The Gwynedd Farmers' Electric Light & Power Company, to furnish service in Upper Gwynedd Township, and the Superior Electric Light & Power Company, to furnish service in Upper Dublin Township.

PHILADELPHIA, PA.—The M. J. Roche Construction Company, Johnson Building, Cincinnati, O., has submitted a low bid to the Bureau of Yards & Docks, United States Government, for the construction of a one-story reinforced-concrete power plant at the local League Island Navy Yard, about 100 by 265 feet.

PHILADELPHIA, PA.—The Kali Manufacturing Company, 1406 North Front Street, manufacturer of chemicals, etc., will install new motor-driven equipment to increase plant capacity.

PITTSBURGH, PA.—The Duquesne Light Company has filed plans for improvements in its building at Broad and Beatty Streets, East End, to cost about $17,000.

POTTSVILLE, PA.—The Philadelphia & Reading Coal Company has commenced the construction of a new transmission line to Hecksherville for local light and power service.

READING, PA.—The City Council has approved an appropriation of $15,000 for improvements and extensions in the fire alarm system.

YEADON, PA.—The Theodore Presser Company, 1712 Chestnut Street, Philadelphia, has awarded a contract for the construction of a new one-story power station, about 65 by 100 feet, at its local plant, to the Wills-Ludwick Company, 34 South Seventeenth Street, Philadelphia, at a cost of $20,000.

DOVER, DEL.—The Canada Gas & Electric Corporation has been incorporated with $5,000,000 capital to operate gas and electric plant. Address L. B. Phillips of Dover.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company has awarded a contract for the proposed new engine plant addition to its Spring Garden station to the B. F. Bennett Building Company, 123 South Howard Street. The structure will be about 40 by 70 feet.

RICHMOND, VA.—The City Council has authorized extensions in the city lighting plant. The P. J. White & Son Company has received the contract for the work.

MARTINSBURG, W. VA.—The Potomac Light & Power Company will install two new 1,000 horsepower water turbines at its local plant, reconstructing and remodeling the present dam to provide for the installation. Contract for the water wheel equipment has been awarded to James Leffel & Company, Springfield, O., and for the electric equipment to the Electric Machinery Company, Minneapolis, Minn. Sanderson & Porter, 52 William Street, New York, are engineers.

ROANOKE, N. C.—The Roanoke Power Company has made a contract with the Roanoke Mills Company to furnish electric power for the operation of about 23,000 spindles at its plant, Roanoke Rapids. The company's transmission system extends through this section.

THOMASVILLE, N. C.—Frank A. Weston has prepared plans for the erection of a $7,000 telephone plant for the Thomasville Telephone Company.

SPARTANBURG, S. C.—Contract has been awarded by the Blue Ridge Power Company for the Green River water power development at Tuxedo, N. C. A 15,000-horsepower plant will be erected and transmission lines will be built to Henderson, N. C., and Spartanburg, S. C.

NORTH CENTRAL STATES.

ALLIANCE, O.—The Cope Electric has been organized with a capital of $25,000 by Arthur L. Cope.

DE GRAFF, O.—This village is considering the sale of its municipally-owned electric light plant. Bids on the property are being asked.

GREENSBURG, O.—The Greenspring council has ordered the issue of $6,500 worth of bonds for the purchase of the electric light plant, owned by the Greenspring Electric Light & Power Company.

MIAMI, O.—Lightning did $3,000 damage recently to the plant of the Defiance Gas & Electric Company, at Miami. The plant was closed for nearly 18 hours. Several of the small towns which the company supplies were without power or lights for some time.

NILES, O.—The Ohio Steel Products Company has increased its capital stock from $70,000 to $100,000. The company recently contracted with a local power company for electric current to operate its plant here, which is to be extended and improved.

WEST MANSFIELD, O.—The citizens voted at a special election to sell the municipally-owned electric light plant. High cost of operation caused dissatisfaction. Address City Clerk.

GARY, IND.—After June 15 Gary and Southern cars between Gary and Crown Point will be driven by power from the Northern Indiana Gas & Electric Company, the Geist syndicate. The Geist Company will build a long line extending from Hammond and the road will be forced to install all new equipment in their power station at Lottaville.

INDIANAPOLIS, IND.—The Public Service Commission authorized the Indiana Power & Water Company, headed by H. I. Clark and represented by Bernard Korbly, to buy the electric light and power plants at Vincennes, Petersburg and Duggar. These properties have been owned by the Eastern Power & Light Corporation. The citizens of Vincennes, Petersburg and Duggar are being given lower electric rates, especially for power, and what the commission believes to be improved service.

SELIERSBURG, IND.—The Silver Creek Telephone Company has been incorporated with $60,000 capital and will erect telephone lines and exchanges. Address Walter B. McCannon, director.

DIXON, ILL.—The Illinois Utilities Company of Dixon was authorized by the state Public Utilities Commission to issue five per cent bonds aggregating in amount $525,000. Of the money derived from the sale of the bonds the sum of $37,924 is to reimburse the company for money spent, and $408,325 for construction, extension and improvement of the company's electric lines.

GALESBURG, ILL.—The Galesburg Railway & Lighting Company has recently closed a deal to take over the holdings of the Weinberg Brothers and subsidiary companies, and the local McKinley company began operation of the Weinberg plants. The latter company contemplates the expenditure of $50,000 in improving the acquired properties and $25,000 probably will be spent next year in enlarging and developing Lake Lady Washington for water supply purposes. These improvement plans call for an electric pumping station at the lake, together with a pipe line from the lake to the central McKinley power plant. The plans also contemplate the raising of the dam to increase the capacity of the lake to 33,000,000 gallons.

SPRINGFIELD, ILL.—Extension of the

franchise of the Springfield Gas & Electric Company in exchange for its burying all wires in a conduit system is proposed by the Springfield Commercial Association in a communication in the form of an ordinance offered the city council at its meeting. Thomas Rees is chairman of the Conduit Committee of the Commercial Association.

FLINT, MICH.—The State Railroad Commission has authorized the incorporation of the Flint & Great Lakes Railway Company with a capital stock of $100,000. The road will operate between Crago at the point of intersection of the D. U. R. tracks to a point near the Buick factories in the city of Flint.

INGALLS, MICH.—A new telephone company has been organized and will be known as the East Ingalls Telephone Company. Thomas Colins, president.

ST. JOHN, MICH.—The coming of additional factories has made it necessary to enlarge the city electric plant. The Board of Public Works is investigating the matter and finds the new machinery will cost from $30,000 to $40,000. Address the city clerk.

CHIPPEWA FALLS, WIS.—The Wisconsin-Minnesota Light & Power Company has started work on a transmission line between Boyd and Stanley, which in the near future will be supplied from the plant at Chippewa Falls.

MILWAUKEE, WIS.—The Milwaukee Electric Railway & Light Company has purchased a 600-acre tract on the shore of Lake Michigan, in the suburbs of the city, and has commenced work on the construction of a $1,000,000 power house. The company is also erecting a storehouse 40 by 110 feet, of brick and steel, on its property near the state fair park.

ST. PAUL, MINN.—Legislation was put under way by the city council for a great way of light to extend on West University Avenue from Rice Street to Bedford Street, a distance of about five miles. The council passed a preliminary order for the improvement. Address city electrician.

SOUTH ST. PAUL, MINN.—B. W. Day, 601 Endicott Building, St. Paul, is preparing plans for a telephone building to be erected here by the Northwestern Telephone Exchange Company, 39 East 35th Street, St. Paul.

WOODLAND, MINN.—Arch. W. T. Bray, Fidelity Building, Duluth, has prepared plans for the erection of a telephone exchange for the Tri-State Telephone Company.

CLARMONT, IA.—The Northwestern Iowa Power Company has been incorporated with a capital of $750,000. The company has restored the old water power of the Governor Larrabee grist mill at Clarmont, installed an electric plant run by the water power, and has extended its lines all over Fayette County and into the edges of Clayton, Buchanan, Delaware, Bremer and Chickasaw counties, with eighteen towns in the circuit, with others likely to come in soon. The general nature of the business of the company is to conduct the lighting, heating, power and water business, to own, purchase, acquire, construct, maintain and operate gas works, electric light, heating and power plants. Christian Miller of Clarmont, president.

MOSCOW, IA.—The telephone exchange of Moscow was destroyed by fire. Address general manager.

SWEA CITY, IA.—The Harrison Township Telephone Company has been organized with a capital of $1,000. J. E. Kelly, president.

WAPELLO, IA.—The Wapello electric light plant was completely destroyed by fire at a loss of $10,000.

KENNETT, MO.—G. N. Laswell and C. L. Coble have secured the light franchise for the town of Bernie and will install a plant.

POPLAR BLUFF, MO.—Plans are being formulated by the city council to install a new lighting system in the public square.

ROCKPORT, MO.—The question has been raised as to legality of the franchise granted to Clifton & Hamer. It has been alleged that the special election held to authorize the sale of the light plant was not according to law, and that consequently the present company is operating without contract or franchise. The electric light plant needs a small machine to run the plant when the load is light and thus relieve the large generator from constant service.

DATES AHEAD.

Electrical Contractors' Association of Pennsylvania. Annual convention, Philadelphia, Pa., June 19-21. Secretary, M. J. Sellers, 1518 Sansom Street, Philadelphia, Pa.

American Institute of Chemical Engineers. Semi-annual meeting, Buffalo, N. Y., June 20-22. Secretary, J. C. Olsen, Cooper Union, New York City.

Electrical Contractors' Association of the State of Illinois. Annual meeting, Peoria, Ill., June 22-23, Secretary, L. B. Van Nuys, Peoria, Ill.

American Institute of Electrical Engineers. Annual convention, New York, N. Y., June 27-28. Secretary, F. L. Hutchinson, 33 West Thirty-ninth Street, New York City.

National Electrical Credit Association. Annual meeting, Boston City Club, Boston, Mass., June 28-29. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago, Ill.

DODGE CITY, KANS.—The Dodge City Experiment Station has been discontinued and the machinery and equipment shipped to the station at Garden City. Extensive improvements are planned for this station. The pump that supplied the water for irrigation will no doubt be replaced by a better one.

DOUGLAS, KANS.—Bids are being received at the office of the city clerk for furnishing equipment and installation of pole line and electric plant for street light.

DOWNS, KANS.—Application has been made by the Solomon Valley Power Company to sell its big central power plant here to A. E. Fitkin & Company of Chicago. It is the general belief that the plant will be closed down and power furnished from Concordia, Kans.

FREDONIA, KANS.—It is proposed to light the alleys in the business district.

LEOTI, KANS.—P. D. Krehbiel has sold his interests in the local telephone exchange to W. T. Wisecup of Haven, Kans. Considerable repair work on most of the lines will have to be done.

PAILA, KANS.—A special election has been called for July 10 to vote on the franchise asked for by the People's Electric Light Company.

PRATT, KANS.—A severe tornado wrecked the city light plant June 5.

WEBSTER, KANS.—The Webster Telephone Exchange has been sold to M. Trus of Woodston, Kans.

WESTMORELAND, KANS.—A transmission line, connected to Rocky Ford power plant, is being extended from Manhattan to Alma, Kans., to furnish light to latter city. A proposal has also been made to Wamego and Marys to supply those towns with light and power.

WICHITA, KANS.—A dam across the Little Arkansas River at its mouth was blown out by dynamite June 4 to protect the power plant of the Kansas Gas & Electric Company from being washed into the river.

GARRISON, N. D.—Garrison, Ryder, Max & Douglas will be supplied with current day and night by the Garrison Coal, Light & Power Company, which is the first in North Dakota to generate its power at the mine. The corporation owns one of the finest lignite beds in central North Dakota. C. W. McGary is president of the company.

TURTLE LAKE, N. D.—The McLean County Farmers' Telephone Company plans to erect a 100-mile line at a cost of $10,000 and has incorporated with A. B. Buck of Busco and Carl Helmbrecht of Turtle Lake as directors.

SOUTH CENTRAL STATES.

BARBOURVILLE, KY.—The Barbourville Electric Light & Power Company will establish and operate its own coal mine to make sure of a continuous coal supply.

OWINGSVILLE, KY.—Suspension of service by the Owingsville Electric Light Company is expected to be a result of the advance in coal prices. The company, which has not been successful financially, can see nothing but loss on high-priced coal. Prooposals to operate with all engines or with water power from a nearby stream are under consideration.

SEBREE, KY.—The Sebree Light & Power Company, capital stock $8,100, has filed articles of incorporation, the incorporators being Henry Powell, J. J. Korb and D. W. McMullin.

KNOXVILLE, TENN.—The council has authorized $100,000 in bonds for modernizing the fire apparatus and improving the fire alarm and police call system. J. P. Powers, city attorney, is in charge.

FAYETTE, MISS.—$17,000 in bonds have been authorized for the use in municipal improvements, especially for installing a new power plant.

NATCHEZ, MISS.—The contract has been awarded to Brown & Henderson of Natchez for the establishment of a light plant for Jefferson Military College.

LIMA, OKLA.—The Peoples Telephone Company has been incorporated with $5,000 capital by J. K. Hubbard, manager.

OKARCHE, OKLA.—An election will be held July 3 to vote on a proposition to grant an electric light franchise to the Central Oklahoma Light & Power Company.

OKLAHOMA CITY, OKLA.—The Peoples' Telephone Company, of Lima, Okla. Capital, $5,000. Incorporators: J. K. Hubbard, R. G. Dunlap and G. B. Cross.

OKLAHOMA CITY, OKLA.—Fifty property owners have signed contracts for a white way to be established on Broadway from Grand Avenue north to Seventh Street.

SUPPLY, OKLA.—An election will be called June 25 to vote $6,000 in bonds to construct an electric plant. C. E. Herschberger, clerk.

YALE, OKLA.—Yale Telephone Company chartered with a capital stock of $10,000 by L. W. Scherer, E. L. Scherer and W. J. Scherer.

AMARILLO, TEX.—The city of Amarillo is contemplating buying the electric light, water works and pumping plant. The sale price offered was $416,124, not including the improvement on the plant now under way.

CLARKSVILLE, TEX.—An electric lighting plant will be added to the improvements at the Country Club, four miles north of the city. A. L. Robins, president.

COLUMBUS, TEX.—The Columbus Electric Light Company has leased for a period of twelve months the municipal water works plant. It will add machinery and enlarge the pumping facilities.

DALLAS, TEX.—It is announced by E. P. Turner, president of the Dallas Southwestern Traction Company, that engineers are now at work securing the driveway for the proposed interurban electric line that is to be built from Dallas to Irving. The construction work will be done by the Creek Construction Company of Sulphur, Okla., of which Judge J. O. Lyttle is the president and George A. Kadine is superintendent.

DALLAS, TEX.—The Fort Bend Telephone Company has been incorporated here with a capital stock of $30,000. Incorporators are C. H. Waddell, J. H. Waddell and G. F. Waddell.

DEL RIO, TEX.—The Western Telephone Company has increased its capital stock from $100,000 to $200,000.

SAN ANTONIO, TEX.—Arch. Sanguinet and Staats have prepared plans for the erection of a telephone exchange for the Southwestern Telegraph & Telephone Company.

VICKERY, TEX.—At the last meeting of the Civic League a committee was appointed to investigate the possibility of getting telephone service.

WESTERN STATES.

GREAT FALLS, MONT.—Extensive improvements and additions to the local system of the Mountain States Telephone & Telegraph Company are in progress. Plans provide for the building of new exchanges at Geraldine and Brady. J. W. Galley, district plant manager, is in charge of the work.

LIVINGSTON, MONT.—Contract for the installation of an ornamental lighting system in the business district has been let to the Montana Power Company at $9,000. Work on the new system will start at once.

MOGOLLON, N. M.—The Oaks Mining Company will install an electric pump in the shaft of its mine near here.

CHLORIDE, ARIZ.—The Desert Power & Water Company of this place has completed plans for the construction of a

new two-story concrete transformer station to cost approximately $12,000. Construction will begin at once.

WICKENBURG, ARIZ.—The city council will receive bids up to June 23rd for the construction of a complete electric lighting system as per specifications.

BRIGHAM CITY, UTAH.—The Phoenix Construction Company has established headquarters here preliminary to the beginning construction work on the transmission line of the Utah Power & Lighting Company from Grace, Idaho, to Salt Lake, Utah.

MONROE, UTAH.—At a citizens' meeting it was decided to rebuild the electric power plant which was destroyed by fire February 22, since which time light and power have been furnished by the Southern Utah Power Company.

GRANGEVILLE, IDA.—Grangeville Electric Light & Power Company will construct a concrete dam to replace a timber-crib dam and will build a pipeline of wood-staves to replace a 4,000-ft. pipe line of insufficient capacity. The plans provide for increasing the generating plant to 1,500 to 2,000 horsepower. The proposed improvements involve an expenditure of $75,000. Eugene Enloe, president, Grangeville.

WALLACE, IDA.—The Shoshone County Power Company has been organized to build and operate a power transmission line to the Murray district, to supply power to the Yukon Gold Company, which will soon begin dredge operations in that district. The incorporators are D. L. Huntington, H. L. Bleerer, C. S. McCalla and A. F. Steel, all of Spokane, Wash., and Therret Towels, of Wallace.

BREMERTON, WASH.—Plans are being hurried by the Bureau of Yards and Docks, Washington, D. C., for the proposed $150,000 power plant and distributing system at this yard.

Everett, Wash.—The Everett Gas Company has applied to the County Commissioners for franchise to construct, maintain and operate an electric transmission line over certain roads in Snohomish county to transmit current for heating, lighting and power.

NORTH YAKIMA, WASH.—Pacific Telephone & Telegraph Company, Stuart Building, Seattle, has made plans for improvements in Yakima valley, estimated to cost $100,000. This includes laying underground and aerial cables in North Yakima at a cost of $15,000 to $20,000, and extensions and relocations of lines in other parts of the valley, estimated to cost $75,000. J. Dunphy, district plant superintendent, District Engineer Shepherd, and Construction Engineer E. Pugsley were recently in North Yakima preparing for the proposed work, which will be started September 1.

SEATTLE, WASH.—The American Nitrogen Products Company, C. J. Graff, president, is doing preliminary work for its proposed power and nitrogen products plant on the Sultan River, Snohomish County, Wash. It is given out that the plant will cost approximately $1,000,000.

SEATTLE, WASH.—The opening of bids for the proposed $3,000,000 hydro-electric plant for the municipality has been postponed to July 20. The specifications call for the erection of a plant capable of delivering to Seattle 25,000 kilowatts for a period of five hours per day or 13,000 kilowatts continuously.

TACOMA, WASH.—Plans for a new power plant for the Kapowsin school have been prepared by Heath & Gove of this city, who will call for bids within a short time.

ASTORIA, ORE.—The Port Commission plans the installation of a semi-Diesel oil engine and equipment to produce power and light, to cost about $16,000.

EAGLE ROCK, CAL.—The Glendale & Montrose Railroad Company has been granted a permit for a single street car track in the vicinity of its proposed depot.

LATON, CAL.—I. Tielman, T. D. Maryhall and A. G. King have been chosen directors of the recently incorporated Laton Telephone Company.

LOS ANGELES, CAL.—The recently organized Southern California Telephone Company has set aside close to $750,000 for connecting and consolidating the Pacific and Home systems in and about Los Angeles. About $250,000 will be spent for new switchboards, additions to existing switchboards and other equipment; $14,000 will be spent on the long-distance systems; about $30,000 will be spent in installing and improving private branches, and the remainder in consolidating Pacific and Home exchanges at various points.

LOS ANGELES, CAL.—An ornamental lighting system is to be placed along Hill Street in this city.

OXNARD, CAL.—The Oxnard Home Telephone Company is to install a new switchboard, a new charging machine and other equipment.

SAN FRANCISCO, CAL.—The California State Railroad Commission has authorized the Pacific Electric Railway Company to construct spur tracks and sidings at grade in Rialto, Cal.

SALINAS, CAL.—The city council has ordered the installation of forty-five electroliers.

SAN LUIS OBISPO, CAL.—The Pacific Telephone & Telegraph Company is to improve and extend its system. An additional line will be run to Avila, and central office equipment will be put in at Atascadero Colony. Estimated that $12,170 will be spent for aerial cable and [illegible] lines.

SANTA BARBARA, CAL.—The Santa Barbara Gas & Electric Company has completed plans for connecting the system with the hydro-electric system of the Southern California Edison Company. The transmission line, sub-station and equipment will cost approximately $200,000.

INCORPORATIONS

NEW YORK, N. Y.—A. Shemel & Company. Capital, $30,000. To manufacture electric fixtures and machinery. Incorporators: M. Zucker, M. S. Hoham and A. Shemel, 11 West One Hundred and Thirteenth Street.

NEW YORK, N. Y.—Ozone-Aqua Electric Healer Company. Capital, $100,000. To manufacture medical electrical appliances. Incorporators: A. R. Starr, J. J. Vonhentzel and B. W. Kirschner, 133 West Seventy-second Street.

BAYONNE, N. J.—Dugan-Foerst Engineering Company. Capital, $25.000. General electrical engineering business. Incorporators: John F. Foerst, John J. and J. E. Dugan, all of Bayonne.

PASSAIC, N. J.—Air Engineering Company. Capital, $50,000. Electrical engineering work. Incorporators: Thomas Foxhall and Edward T. Moore, Passaic, and John H. Thomas, Belleville. Office, 255 Main Avenue.

WILKES-BARRE, PA.—Shepherd-Rust Company. Capital, $75,000. To operate in connection with Shepherd & Rust, 42 West Market Street, and manufacture electric lighting fixtures. Harold N. Rust, principal incorporator.

PHILADELPHIA, PA.—West Bradford Township, Pocopson Township and Dilworth Township Electric companies, to operate in Chester County. J. C. Murtagh, principal incorporator.

COATESVILLE, PA.—Pocopson, Uwchland, New Electric, Goshen Electric and East Caln Light, Heat & Power companies, to operate in Chester County. John E. Zimmerman, principal incorporator.

CHICAGO, ILL.—National Electric Vending Company. Incorporated in Delaware with capital of $500,000 to manufacture electric vending machines. Incorporators: Leonard L. Cowan, B. F. Cowan and R. Montgomery, all of Chicago.

DOVER, DEL.—Canada Gas & Electric Corporation. Capital, $5,000,000. To operate electric and gas plants. Incorporators: L. B. Phillips and J. B. Bailey, Dover.

NEWARK, N. J.—Ajax Electric & Manufacturing Company. Capital, $125,000. To manufacture electric specialties. Incorporators: Rudolph Bauman, Newark; W. W. Bliecke and R. S. Hicks, Orange.

POUGHKEEPSIE, N. Y.—The Permaliffe Storage Battery Company. Capital, $1,000,000. To manufacture storage batteries and electric machinery. Incorporators: E. P. Sheehy and E. T. Coffin.

WILMINGTON, DEL.—Hopple Electric Window Control, Inc. Capital, $250,000. To manufacture a patented electric window control. Incorporators: F. D. Buck, M. L. Horty and K. E. Longfield, Wilmington.

JOLIET, ILL.—The Oakland Electric Company has been organized by Peter Voras and Robert D. Snapp.

CHICAGO, ILL.—The B. & K. Electric Manufacturing Company. Capital, $50,000. Incorporators: E. J. Kingsbury, E. J. Prescott and C. H. Fox.

CINCINNATI, OHIO.—The Trimmer-Haynes Electric Manufacturing Company. Capital, $20,000. Incorporators: J. H. Trimmer, G. D. Haynes, Allen Weber, W. J. Rieker and G. J. Fredericks, Jr.

CINCINNATI, OHIO.—The Liebel-Florsheim Company to manufacture electrical appliances. Capital, $30,000. Incorporators: John G. Liebel, Edwin S. Florsheim, C. S. Liebel and George Stugard.

PROPOSALS

MOTOR-DRIVEN MACHINERY.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids at early dates not yet specified for the following machinery. Intending bidders should apply to the Bureau for copies of the schedules mentioned. Four motor-driven hydraulic pumps for operating 500 and 3,000-ton presses, for delivery at Charleston, W. Va.; schedule No. 1219; three six-ton electric furnaces, Charleston, W. Va., schedule No. 1220; two portable drills, two 30-inch radial drills, two 16-inch sensitive drills, two two-wheel column-type emery grinders, two portable surface grinders, two 4-inch capacity backsaws, two back-geared, extension-gap, screw-cutting lathes, four all-geared-bed, tool-room, screw-cutting lathes, two constant-speed, universal milling machines, two column-type tool-room shapers, all motor-driven and for delivery at Brooklyn, N. Y., and Mare Island, Cal., schedule No. 1221; one double-angle motor-driven shears, Charleston, S. C., schedule No. 1204.

FINANCIAL NOTES

PACIFIC POWER & LIGHT.

Pacific Power & Light Company, subsidiary of American Power & Light Company, reports earnings for April and four months as follows:

	1917.	1916.
April gross .....$	276,191	$ 255,828
Net after taxes.....	177,981	172,042
Surplus after charges.	82,756	74,404
Four months' gross...	1,091,399	1,017,244
Net after taxes.....	672,458	659,756
Surplus after charges.	295,496	271,156

Report excludes interest on $2,338,000 6 per cent collateral trust gold notes, due July 1, 1917 (which is reported as paid directly by the Southern California Gas Company), and excludes revenue derived from Southern California Gas Company.

NORTHERN STATES POWER.

H. M. Byllesby & Company reports an increase of 9.3 per cent in the net earnings of Northern States Power Company for the month of April, 1917, as compared with April, 1916. The net increase for the year ended April 30 was 11.9 per cent. Comparative figures are as follows:

Mo. of April—	1917.	1916.	Inc.
Gross earnings..$	550,325	$ 475,251	$75,074
Net earnings....	286,374	261,917	24,457
Year ended Apr. 30—			
Gross earnings..	6,428,124	5,472,601	955,523
Net earnings....	3,420,508	3,055.380	365,128

A circular concerning the new issue of $1,500,000 preferred stock by Northern States Power Company estimates that annual net earnings will be increased approximately $100,000 as a result of the acquisition of new properties with the proceeds of the issue.

PUBLIC UTILITY DIVIDENDS.

American Public Utilities Company has declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable July 2 to stock of record June 20.

The company reports exceptionally large business, and earnings are showing good increases. The demand for power on the Wissota dam has been largely increased, the northern part of Wisconsin and the Twin Cities taking greater quantities than heretofore.

Springfield (Mo.) Railway & Light Company has declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable July 2 to stockholders of record June 15.

THE ARIZONA POWER COMPANY.

Comparative statement of earnings and expenses, month of March:

	1917.	1916.
Gross earnings	$ 36,961.14	$ 21,792.60
Operating expenses and taxes	11,119.26	6,866.24
Net earnings	$ 25,841.88	$ 14,926.36
Other income	15.00	15.00
Total income	$ 25,856.88	$ 14,941.36
Bond interest	$ 9,192.17	$ 9,241.67
Note interest	1,333.33	.....
General interest	549.13	17.00
Depreciation reserve	1,848.05	1,089.63
Net income	$ 12,934.20	$ 4,593.06
Operating ratio	30.1%	31.5%

Twelve months ended March 31:

	1917.	1916.
Gross earnings	$357,573.20	$231,775.72
Operating expenses and taxes	114,510.95	70,053.55
Net earnings	$243,062.25	$161,722.17
Other income	219.18	408.48
Total income	$243,281.43	$162,130.65
Bond interest	$110,832.17	$110,991.67
Note interest	11,999.99	.....
General interest	8,518.44	175.69
Depreciation reserve	17,891.59	11,588.71
Net income	$ 94,039.24	$ 39,374.58
Operating ratio	32.1%	30.2%

Issued by William P. Bonbright & Co. Inc., corner Nassau and Cedar Streets, New York City, June 6, 1917.

EXCELSIOR SPRINGS WATER, GAS & ELECTRIC.

Comparative statement of earnings and expenses is as follows:

Month of April:	1917.	1916.
Gross earnings	$11,074.76	$10,314.03
Operating expenses and taxes	5,962.58	5,104.26
Net earnings	5,112.18	5,209.77
Operating ratio	53.8%	49.6%

Note.—High operating expenses due in the main to fuel cost.

Twelve months ended April 30:

	1917.	1916.
Gross earnings	$127,636.30	$114,418.12
Operating expenses and taxes	64,143.06	55,472.87
Net earnings	63,493.24	58,945.25
Bond interest	20,390.75	18,299.83
Depreciation reserve	18,000.00	10,400.00
Other deductions	306.00	306.00
Net income	24,796.49	29,939.42
Preferred dividend	12,000.00	12,000.00
Balance	12,796.49	17,939.42
Operating ratio	50.3%	47.6%

Note.—Special dividends were paid on the common stock as follows: 2% in March, 1915 (amounting to $6,000); 3% in February, 1916 ($9,000); 2% in September, 1916 ($6,000), and 2% in February, 1917 ($6,000).

PHILADELPHIA COMPANY.

Philadelphia Company and affiliated operating companies report earnings, classified by departments, for April as follows:

Natural gas department:	1917.	1916.
Gross earnings	$ 906,352	$ 857,514
Net	529,603	593,256
Oil department:		
Gross earnings	$ 47,321	$ 20,098
Net	36,639	13,912
Coal department:		
Gross earnings	$ 127,251	.....
Net	79,280	.....
Electric light and power department:		
Gross earnings	$ 680,638	$ 529,459
Net	236,468	255,782
Street railway department:		
Gross earnings	$1,170,029	$1,123,424
Net	327,245	423,907

APPALACHIAN POWER COMPANY.

Comparative statement of earnings and expenses is as follows:

Month of March:

	1917.	1916.
Gross earnings	$ 70,986.37	$ 63,982.87
Operating expenses and taxes	31,224.16	27,908.82
Net earnings	$ 39,762.21	$ 36,074.05
Other income	69.27	320.48
Total income	$ 39,831.48	$ 36,394.53
Operating ratio	44.0%	43.6%

Twelve months ended March 31:

	1917.	1916.
Gross earnings	$821,176.38	$680,107.26
Operating expenses and taxes	363,125.70	316,133.84
Net earnings	$458,050.68	$363,973.42
Other income	3,551.99	780.09
Total income	$461,602.67	$364,753.51
Bond interest	$281,436.38	$272,500.00
Note interest	160,235.05	152,060.47
General interest	13,359.81	8,767.29
Less interest charged to construction*	.....	134,491.99
Net income	$ 6,571.43	$ 65,917.74
Operating ratio	44.2%	46.5%

*No interest has been charged to this account since March, 1916.

PACIFIC GAS & ELECTRIC COMPANY.

(Arizona.)

Comparative statement of earnings and expenses is as follows:

Month of April:

	1917.	1916.
Gross earnings	$ 36,264.07	$ 31,179.66
Operating expenses and taxes	22,629.05	21,597.01
Net earnings	$ 13,635.02	$ 9,582.65
Other income	39.15	57.83
Total income	$ 13,674.17	$ 9,640.48
Operating ratio	62.4%	69.1%

Twelve months ended April 30:

	1917.	1916.
Gross earnings	$418,196.45	$372,105.65
Operating expenses and taxes	266,817.54	258,321.43
Net earnings	$151,378.91	$113,784.22
Other income	1,361.75	9,540.86
Total income	$152,740.66	$123,425.08
Bond interest	$ 52,362.34	$ 51,748.17
General interest	1,408.41	2,324.46
Depreciation	44,995.41	35,091.61
Net income	$ 53,974.50	$ 34,260.84
Preferred dividend	35,000.00	35,000.00
Surplus	$ 18,974.50	*$ 739.16
Operating ratio	63.6%	72.0%

*Deficit.

WEEKLY COMPARISON OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRIC COMPANIES.

Quotations furnished by F. M. Zeiler & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. rate per cent.	Bid June 5.	Bid June 12.
Adirondack Electric Power of Glens Falls, common	..	20	20
Adirondack Electric Power of Glens Falls, preferred	6	76	75
American Gas & Electric of New York, common	10+extra	120	120
American Gas & Electric of New York, preferred	6	48½	48
American Light & Traction of New York, common	..	329	329
American Light & Traction of New York, preferred	6	110	110
American Power & Light of New York, common	4	67	66
American Power & Light of New York, preferred	6	89	88
American Public Utilities of Grand Rapids, common	..	28	28
American Public Utilities of Grand Rapids, preferred	6	64	64
American Telephone & Telegraph of New York	..	122¼	121⅝
American Water Works & Elec. of New York, common	..	7¼	7
American Water Works & Elec. of New York, particip	7	22	22
American Water Works & Elec. of New York, first preferred	..	75	75
Appalachian Power of Bluefield, common	..	5	5
Appalachian Power of Bluefield, preferred	7	30	30
Cities Service of New York, common	6+extra	288	283
Cities Service of New York, preferred	6	87	84½
Commonwealth Edison of Chicago	8	121	122
Comm. Power, Railway & Light of Jackson, common	4	48	48
Comm. Power, Railway & Light of Jackson, preferred	6	74	74
Federal Light & Traction of New York, common	..	10	10
Federal Light & Traction of New York, preferred	..	43	42
Illinois Northern Utilities of Dixon	6	78	78
Middle West Utilities of Chicago, common	2+2 extra	42	42
Middle West Utilities of Chicago, preferred	6	68	68
Northern States Power of Chicago, common	7	92	96
Northern States Power of Chicago, preferred	7	98	97
Pacific Gas & Electric of San Francisco, common	5	59	59
Pacific Gas & Electric of San Francisco, preferred	6	89	89
Public Service of Northern Illinois, Chicago, common	7	90	92¼
Public Service of Northern Illinois, Chicago, preferred	6	95	97
Republic Railway & Light of Youngstown, common	4	30½	30¾
Republic Railway & Light of Youngstown, preferred	6	66	64½
Standard Gas & Electric of Chicago, common	..	10	11
Standard Gas & Electric of Chicago, preferred	6	35	35
Tennessee Railway, Light & Power of Chattanooga, common	..	5¾	5½
Tennessee Railway, Light & Power of Chattanooga, preferred	6	25¼	25
United Light & Railways of Grand Rapids, common	4	38	38
United Light & Railways of Grand Rapids, preferred	6	69	68
Western Power of San Francisco, common	..	14	14½
Western Power of San Francisco, preferred	6	51	52
Western Union Telegraph of New York	5+extra	94½	93½
Industrials—			
Electric Storage Battery of Philadelphia, common	4	61½	62⅞
General Electric of Schenectady	8	164	162
National Carbon of Cleveland, common	8	*	*75
National Carbon of Cleveland, preferred	7	*	*133
Westinghouse Electric & Mfg. of Pittsburgh, common	5+extra	53⅞	53½
Westinghouse Electric & Mfg. of Pittsburgh, preferred	7	68¾	68½

*Last sale.

NEW PUBLICATIONS

GLASSES FOR PROTECTING EYES FROM INJURIOUS RADIATION.—The Bureau of Standards, Washington, D. C., has issued technologic paper No. 93, entitled "Glasses for Protecting the Eyes from Injurious Radiations." This paper was prepared as a result of a study by W. W. Coblentz and W B. Emerson. It gives the results of a research of the requirements of such glasses and describes the protective characteristics of representative groups of glasses which are available for protecting the eye from (1) the ultra-violet, (2) the visible, and (3) the infra-red rays. The paper gives the characteristics of black, amber, green, greenish-yellow and red glasses which are efficient in protecting the eye from the ultra-violet rays. Similarly the characteristics of deep black, yellowish-green, sage-green, gold-plated and bluish-green glasses are described, which are efficient in protecting the eye from the infra-red rays.

Electrical Patents Issued June 5, 1917

Prepared by Thomas Howe, Patent Attorney, 2 Rector Street, New York, N. Y.

1,228,392. Speed-Indicating Apparatus. H. E. Beighlee, Cleveland, O. Wheatstone bridge arrangement for indicating the sum of a number of speeds of different devices.

1,228,394. Disinfecting and Advertising Device for Telephones and the Like. L. Block, assignor to (Mrs.) M. Frankl, New York, N. Y. Structure of device for application to mouth piece.

1,228,395. Automatically-Operated Circuit-Breaker. J. M. Bosenbury, Peoria, Ill., assignor of one-half to C. O. Birney, Mount Healthy, O. When motor controller handle is released, fluid pressure device opens motor circuit and vent valve to apply brakes.

1,228,405. Process and Apparatus for Rectifying Alternating Currents of Electricity. W. H. Chapman, Portland, Me. Charges from an alternating source are discharged in the form of a glow discharge, the ions of opposite signs are separated and the rectified charges collected.

1,228,408. Circuit-Breaker. F. J. Cleaver, Carnegie Borough, Pa., assignor of one-half to H. W. Hodgdon, Pittsburgh, Pa. Circuit formed between terminals by a liquid which is expelled from between the terminals on excess current.

1,228,442 and 1,228,443. Arc-Lamp. G. Humber, Denver, Colo. Electrode holders and feeding means.

1,228,449. Electric Motor. S. Ellsworth Kurtz, Sac City, Iowa. Structure of induction motor.

1,228,450. Electric Welding Machine. L. S. Lachman, assignor to Thomson Spot Welder Co., Boston, Mass. Special structure of transformer and electrode arms of spot welder.

1,228,468. Method of Locating Special Transposition-Points. H. Mouradian, assignor to American Telephone & Telegraph Co., Boston, Mass. For determining transposition points in signal circuit to overcome inductive disturbances by neighboring conductors.

1,228,477 and 1,228,478. Dimming Device. R. E. Reed, Ripon, Wis. Structures of variable resistances for insertion in lighting circuits.

1,228,482. Anti-frosting Device. F. Schonger, Kingston, N. Y. Electrically heated structure for mounting on wind shield of vehicle.

1,228,484. Gauze Brush. E. O. Schweitzer, Chicago, Ill. For collecting current from commutators; formed of interwoven metal wires, each having a coating of metal softer than copper for lubrication.

1,228,487. Spark-Plug. F. L. Sessions, Lakewood, O. Structural details.

1,228,497. Automatic Electric Brake. W. V. Turner and F. H. Donovan, assignors to Westinghouse Air Brake Co., Wilmerding, Pa. Circuits of electrically controlled brake.

1,228,507. Illuminated Sign. F. W. Wilson, Elmhurst, N. Y. Structure of globe, support, etc.

1,228,537. Telephone System. W. W. Dean, assignor to Stromberg-Carlson Telephone Mfg. Co., Rochester, N. Y. Details of cord circuit of manual exchange.

1,228,546. Paste for Storage-Battery Plates and Process of Making the Same. L. H. Flanders, Jenkintown, Pa. Paste of desired lead content is obtained from varying oxids of lead and has a lead content adapted to react with sulfating material to chemically set the paste.

1,228,547. Process of Making Pasted Storage-Battery Plates. L. H. Flanders, Jenkintown, Pa. Plates of predetermined capacity are produced from oxids of varying density and lead content.

1,228,551. Negative-Pole Plate for Storage Batteries and Process of Making the Same. W. G. S. Grant and L. H. Flanders, assignors to Electric Storage Battery Co. Dry charged plate of the pasted type.

1,228,577. Electrical Plug and Socket. J. F. McElroy, assignor to Consolidated Car-Heating Co. Structural details.

1,228,581. Wigwag Signal. M. S. Morse, assignor to Railway Specialties Co., Los Angeles, Cal. Structure of contact device.

1,228,609. Process for Making Insulating Material from Basic Magnesium Carbonate and Fibrous Substances. K. Schmid, assignor to Firm of "Lipsia" Chemische Fabrik, Actien-Gesellschaft, Mugeln, Leipzig, Germany. Normal magnesium carbonate is deposited on fibrous mass and converted into basic carbonate by special process.

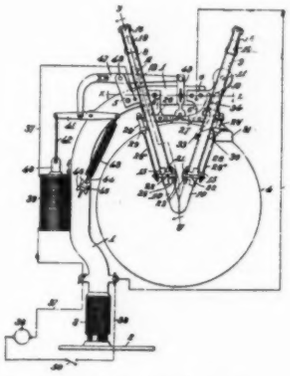
1,228,628. Spark-Plug for Gas-Engines. C. R. Winston, Richmond, Va. Structural details.

1,228,634. Intercommunicating Lock-Out Telephone System. F. W. Adsit, Minneapolis, Minn. Arrangement of switching means and alternating current generator at each station.

1,228,635. Lamp-Dimmer. H. Alexander, New York, N. Y. Arrangement of resistance in lamp socket.

1,228,639. Sound-Producing Device. E. C. Bayer, Jordlose, Svebolle Station, Denmark. Stretched non-magnetic wires of different periods are in a powerful magnetic field in the base of a horn and connected in a telephone transmitter circuit.

1,228,645. Insulated Rail-Joint. B. G. Braine, assignor to Rail Joint Co., New York, N. Y. Has special means for insulating joint bar from rail head.



1,228,442.—Arc Lamp.

1,228,646. Plural-Faced Insulating Unit. B. G. Braine, assignor to Rail Joint Co. Modification of above.

1,228,647. Oscillation-Receiving Apparatus. E. E. Butcher, assignor to Marconi Wireless Telegraph Co. Aerial and open secondary circuit coupled thereto are both tuned to frequency of received oscillations.

1,228,669. Appliance for Light, Heat and Massage Treatment. E. F. Hardey, Kansas City, Mo. Hand implement having light and heat rays projected on treated part and a rubber applicator shielded from the rays.

1,228,670. Flexible Insulated Electrical Conductor. J. C. Henderson, assignor to Driver-Harris Wire Co., Harrison, N. J. Comprises a number of cables, each consisting of fine wires insulated by enamel from each other except at their ends and a fibrous, fire-proof covering for each cable and for the group of cables.

1,228,674. Coin-Controlled Mechanism. J. W. Hughes, Haddon Heights, N. J., assignor to Hughes-Lippincott Co. Tilting coin chute controls circuits according to whether or not a proper coin has been inserted.

1,228,675. Storage-Battery Plate. W. S. Hutchinson, Montreal, Quebec, Canada. Structure of grid for pasted plate.

1,228,678. Automatic Compensating Device. M. Johnson, assignor to Bristol Co., Waterbury, Conn. Wheatstone bridge arrangement for automatically compensating for temperature in a thermo-electric pyrometer.

1,228,702. Electrical Apparatus. J. Schmidinger, New York, N. Y. Mounting of an implement driving motor.

1,228,710. Brush-Lifting Mechanism. C. W. Steen, assignor to Allis-Chalmers Mfg. Co., Milwaukee, Wis. For raising brushes from the commutator of a dynamo electric machine.

1,228,711. Connecting Device for Chain-Type Insulators. L. Steinberger, Brooklyn, N. Y. Insulators are connected together by links, each having ball and socket joint at one end and hinge joint at other.

1,228,719. Electropneumatic Triple-Valve Mechanism for Coupling Systems. C. H. Tomlinson, assignor to Tomlinson Coupler Co., Denver, Colo. Fluid pressure cylinder in car coupler system has electrically-operated valve.

1,228,731. Circuit Extension Box. C. W. Abbott, H. R. Gilson and J. M. G. Fullman, assignors to National Metal Molding Co., Pittsburgh, Pa. Structural details of device for mounting in adjustable relation to an outlet box.

1,228,741. Combination Electric Switch. R. A. Boehm, assignor to B. S. Putts, Erie, Pa. A series of push pins must be operated in certain combination to make circuit.

1,228,749. Reflector-Lamp. E. B. Corcoran, assignor to Corcoran-Victor Co., Cincinnati, O. Mounting and connection of lamp sockets in headlight.

1,228,757. Clock Attachment for Electric Thermostats. F. S. Denison, assignor to Minneapolis Heat Regulator Co., Minneapolis, Minn. Contact posts of a thermostat are adjusted by alarm mechanism of a clock.

1,228,762. Electric-Light Fixture. C. F. Dolls, Cincinnati, O. Casing containing spring-tensioned winding drum and stop devices for lamp cord of pendent lamp.

1,228,767. Spark-Plug and Method of Manufacturing the Same. F. M. Furber, Revere, Mass. Structural details.

1,228,778. Knife-Switch Relay. W. Kaisling, assignor to Kellogg Switchboard & Supply Co., Chicago, Ill. Structural details.

1,228,798. Adjusting Device for Grinding Wheels. M. Maag, Zurich, Switzerland. To compensate for wear, circuit for controlling feed of wheel is controlled by the wear.

1,228,803. Automatic Compensating Device. G. Mertelmeyer, assignor to Bristol Co., Waterbury, Conn. Temperature compensating device for thermo-electric pyrometer.

1,228,814. Thread-Parting Mechanism for Looms. H. A. Owen, assignor to Whitin Machine Works, Whitinsville, Mass. The trailing filling end of a filling bobbin ejected from an automatic filling replenishing mechanism, is severed by pressing against a hot resistor.

1,228,819. Electric Clock. W. E. Porter, assignor to New Haven Clock Co., New Haven, Conn. Electromagnetic mechanism for energizing the driving spring of a time train of a clock.

1,228,823. Food and Beverage Mixing Device. W. P. Robertson, New York, N. Y. Mounting and gearing of motor on standard for mixing materials in glass.

1,228,838. Power-Operated Shears. J. Schutz, assignor of one-half to J. Benovy, Chicago, Ill. Portable shears operated by motor through flexible shaft.

1,228,839. Safety Means for Switch-Boxes. L. Siebenhauer, assignor to Drendell Electrical & Mfg. Co., San Francisco, Cal. Has insulating plate for preventing contact of knife switch with fuses which it controls.

1,228,842. Electric Welding-Machine. J. M. Sparkes, Peabody, Mass. For making a T-weld.

1,228,843. Welding-Machine. W. H. Spire, assignor to Steel Products Co., Cleveland, O. Structure of work holders for butt welder.

1,228,849. System of Electrical Regulation. W. A. Turbayne, assignor to U. S. Light & Heat Corp., Niagara Falls, N. Y. Three-wire system with a pair of regulating batteries and a three-brush booster to maintain a balanced load on the system and a constant load on the generating source.

1,228,852. Control of Alternating-Current Motors. T. W. Varley, New York, N. Y. Arrangement of magnets to control the closure of the circuit and rotation of the motor.

1,228,853. Device of Expanded Metal. T. W. Varley. Fan guard.

1,228,858. Electric Switch. R. S. White, Washington, D. C. For meter test blocks.

1,228,859. Meter-Switch. R. S. White. Modification of above.

1,228,864. Magneto Driving Mechanism. W. B. Wrightsman, Kokomo, Ind. Gearing details.

1,228,865. Apparatus for Applying Therapeutically-Active Rays to the Human Body. E. Zueblin, Baltimore, Md. Structure and support of electrodes.

1,228,892. Radio-Controlled Torpedo. A. E. Ericson, Manchester, Mass., assignor of one-fourth to G. A. Whipple, Binghamton, N. Y. Special apparatus for transmitting and receiving radio impulses controlling the steering gear.

1,228,899. Electric Action for Organs. E. F. Frost, Washington, D. C. Details of contact arrangements for controlling the circuits of note-sounding devices.

1,228,905, 1,228,906 and 1,228,907. Electric-Switch Mechanism. D. D. Gordon, assignor to Yost Electric Mfg. Co., Toledo, O. First two patents: Pull socket structures. Third patent: Key socket structure.

1,228,911. Train Lantern or Marker. J. F. Haddock, St. Louis, Mo. Has special arrangement of oil and adjustable electric lamps with relation to bullseyes.

1,228,924. Drawn-Link Electric Fuse. S. W. Huff, Brooklyn, N. Y. Link is of round section and drawn lengthwise with reduced middle section.

1,228,925. Making Low-Carbon Manganese Alloys. E. Humbert, Niagara Falls, N. Y. Carbon content of ferro-manganese is reduced by adding manganese oxid thereto and electrically heating.

1,228,936. Commutation Device for Direct Current Machines and the Like. B. Ljungstrom and A. D. Widstrom, Stockholm, Sweden. Alternating current generator affected by load on D. C. machine is connected in leads from commutator to armature winding.

1,228,958. Spark-Plug. W. J. O'Gorman, New York, N. Y. Has artificial spark gaps in position to be observed and on both sides of ignition gap.

1,228,969. Device for Suspending Light-Transmitting Bowls. J. T. Robb, Bay Shore, N. Y. A shade and bowl supporting chains are secured to lamp socket cover.

1,228,986 and 1,228,988. Machine for Waterproofing Fibrous Materials. A. O. Tate, assignor to Tate Electrolytic Waterproofing Co., New York, N. Y. First patent: Arrangement of electrodes and means for spraying material with electrolytic agents for rendering the material non-absorbent. Second patent: Modification.

1,228,987. Method of Waterproofing Fibrous Materials. A. O. Tate, assignor to Tate Electrolytic Waterproofing Co. Material is impregnated with solution of sodium palmitate and aluminum acetate to precipitate aluminum hydrate and palmitate and subjecting the impregnated material to electric current between aluminum electrodes to produce an excess of aluminum hydroxid and drive it into the fibres.

1,228,993. Electrical Automatic Control Mechanism. M. G. Vandy, Chicago, Ill. Clock-controlled switch mechanism.

1,229,014. Field-Control Switch. W. A. Atwood, assignor to General Electric Co. Has an auxiliary switch so related to trip of main switch as to close when main switch is opened and open when main switch is closed.

1,229,034. Burglar-Alarm. L. A. Collins, Louisville, Ky. Closing of an alarm circuit releases a weight which lifts a telephone receiver hook and also closes circuit of audible alarm.

1,229,035. Electrical Signaling Device. G. W. Comer, assignor to Auto-Signal Co., Chicago, Ill. Electrically illuminated arm for automobile direction indicator.

1,229,042. Process for Improving the Quality and Yield of Hydrocarbon Cases. J. G. Davidson and R. W. Ford, Vancouver, British Columbia, Canada. Gas is subjected to high tension, silent, electrical discharge.

1,229,045. Distributor for Ignition Systems. W. W. Dean, assignor to Splitdorf Electrical Co., Newark, N. J. Structure of rotating contact device.

1,229,056. Electric-Lamp Receptacle. M. H. Freixas, Brooklyn, N. Y. Structural details.

1,229,075. Apparatus for Handling Metallic Leaf. L. M. Harwood, Springfield, Mass. Has a dielectric for coming in contact with the leaf and a conductor back of the dielectric for inductively attracting the leaf.

1,229,122. Electrical Piano Attachment. D. P. Muse, Junction City, Ark. Piano keys electrically control fingering and string-playing devices of violin, and orchestra bells.

1,229,128. Electric Heating Device. L. F. Parkhurst, assignor to General Electric Co. Toaster.

1,229,149. Commutator. C. J. Schwarze, assignor to Schwarze Electric Co., Adrian, Mich. Structure of radial faced device.

1,229,150. Process for Tanning and Impregnating Materials by Means of Electricity. B. Schwerin, assignor to Elecktro-Osmose Aktiengesellschaft, Berlin, Germany. Material is placed between diaphragms in liquid containing the impregnating substance and current passed between diaphragms, the diaphragms retaining the substance in question, but permitting substances interfering with electric osmosis to pass out.

1,229,155. Absolute and Permissive Block-Signaling. Judson Shoecraft, Eskridge, Kan. Arrangement of circuits for motor-operated signals.

1,229,165. Telephone-Exchange System. H. D. Stroud, assignor to Kellogg Switchboard & Supply Co. Arrangement of

1,228,711.—Connecting Device for Insulator.

manually-operated terminals and selective switches in link circuits.

1,229,177. Focusing Mechanism. C. E. Godley, assignor to Edmunds & Jones Corp., Detroit, Mich. For headlight.

1,229,184. Adjustable Support for Contact Shoes. T. W. Scott and H. V. Rudolph, assignors to American Train Control Co., Baltimore, Md. For third rails.

1,229,185. Incandescent Electric Lamp Plug. G. J. Stichtenoth, Cincinnati, O., assignor of one-half to H. Von Holle, Cheviot, O. Details of special structure.

1,229,186. Safety-Switch. A. K. Sutherland, assignor to Trumbull Electric Mfg. Co., Plainville, Conn. Operation of switch by handle external to casing is controlled by locking and releasing of door and interlocking devices insure predetermined cycle of operation.

1,229,189. Apparatus for Refining Liquids and Gases. J. N. Wingett, assignor to W. A. Haggott, trustee, Denver, Colo. Valve for controlling drawing off of heavier oils from a treating apparatus is controlled electromagnetically by a contact-controlling hydrometer.

1,229,193. Spark-Plug. M. T. Minogus, Philadelphia, Pa. Is adjustable to produce one or two sparks.

1,229,201. Selective Signaling Apparatus. L. M. Potts, assignor to A. McLanahan, Baltimore, Md. Selective elements controlled by spring balance having phase regulated with respect to the signaling current.

1,229,202. Telegraphic Receiver. L. M. Potts, assignor to A. McLanahan, Baltimore, Md. For printing telegraphs.

1,229,203. Method of Purifying and Separating Finely-Divided Substances. G. B. Schwerin, assignor to Gesellschaft fur Elektro-Osmose, M. B. H., Frankfort-on-the-Main, Germany. Electro osmotic process.

Reissues.

14,310. Circuit-Controller. W. K. Howe, assignor to General Railway Signal Co., Gates, N. Y. For railway signaling systems; has middle and two extreme positions with means for preventing operation at former when continuously moved between the two latter.

14,312. Device for Connecting Outside Wires to Buildings. P. C. Ragotzky, Philadelphia, Pa. Circumferentially grooved knob.

Patents Expired.

The following United States electrical patents expired on June 12, 1917:

651,336. Electric-railway Axle. H. M. Brinckerhoff and J. S. Doyle, Chicago, Ill.

651,342. Commutator-truing Device. E. D. Carr, Akron, O.

651,343. Electric Railway. T. P. Chandler, Philadelphia, Pa.

651,350. Electric Railway. W. Grunow, Jr., Bridgeport, Conn.

651,361. Electric Telegraphy. I. Kitsee, Philadelphia, Pa.

651,362. Space Telegraphy. I. Kitsee.

651,363. Method of Transmitting Electric Impulses. I. Kitsee.

651,381. Lubricator. F. M. Peters, Chicago, Ill.

651,396. Production of Chromium Oxide. E. A. G. Street, Paris, France.

651,401. Trolley. J. H. Walker, Lexington, Ky.

651,469. Dental Motor. O. H. Pieper and A. F. Pieper, Rochester, N. Y.

651,471. Electrode for Secondary Batteries. P. F. Ribbe, Charlottenburg, Germany.

651,472. Electrical Appliance for the Cure of Deafness. W. J. Tindall, New York, N. Y.

651,473. Electric-light Dimmer. F. E. Woodford, Appleton, Wis.

651,476. Secondary or Storage Battery. O. T. Bugg, Jr., New York, N. Y.

651,483. Pipe or Conduit for Electrical Conductors. E. T. Greenfield, New York, N. Y.

651,484. Junction Box for Electrical Conductors. E. T. Greenfield.

651,498. Electric Arc Lamp. E. Bonhivers, Levallois-Perret, France.

651,524. Electric Railway. A. Casazza, Hoboken, N. J.

651,540. Automatic Telephone Switch. R. T. Watt, Laurel Springs, N. J.

651,545. Telegraphic Transmitting Apparatus. J. Gardner, Knott End, England.

651,561. Switch for Overhead-trolley Tracks. P. F. Werner, Springfield, Mass.

651,575. Trolley. F. A. Merrick, Johnstown, Pa.

651,595. Electric Switch. W. Ely, Providence, R. I.

651,597. Electric Welding. R. Eyre, Johnstown, Pa.

651,602. Brake Mechanism for Electric-railway Cars. F. W. Garrett, Johnstown, Pa.

651,610. Machine for Covering Wires or Cables with Loose Fibers Suitable for Insulation. F. S. Randall, Wilkes-Barre, Pa.

651,664. System of Electrical Distribution. A. S. Hubbard, Belleville, N. J.

651,672. Electric Elevator. A. B. See, New York, N. Y.

651,674. Automatic Cab Signal. H. Stadelmann, Jr., Apolda, Germany.

651,680. Electric-battery Attachment. H. B. Ware and C. C. Cornell, Wymore, Neb.

651,695. Contact for Incandescent-lamp Bases, etc. W. C. Bryant, Bridgeport, Conn.

651,697. Electric-current Shunting Device. E. R. Cliff, New York, N. Y.

651,718. Method of Electrically Treating Ores of Nickel, etc. H. Leleux, Paris, France.

651,733. Electric Arc Lamp. W. F. Wegner, West Superior, Wis.

651,771. Electrical Measuring Instrument. E. C. Rimington, London, England.

651,777. Electrotherapeutic Apparatus. F. H. Brown, Chicago, Ill.